US009200794B2

(12) **United States Patent**
Clifford

(10) **Patent No.: US 9,200,794 B2**
(45) **Date of Patent: Dec. 1, 2015**

(54) **FAN COOLED LED LIGHT AND HOUSING**

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(72) Inventor: **Scott Clifford**, Mesa, AZ (US)

(73) Assignee: **LEDLab, LLC**, Mesa, AZ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/454,462**

(22) Filed: **Aug. 7, 2014**

(65) **Prior Publication Data**

US 2014/0354155 A1 Dec. 4, 2014

Related U.S. Application Data

(63) Continuation of application No. 14/327,341, filed on Jul. 9, 2014, which is a continuation-in-part of application No. 13/938,093, filed on Jul. 9, 2013, which is a continuation-in-part of application No. 13/908,690, filed on Jun. 3, 2013.

(51) **Int. Cl.**

F21V 29/02	(2006.01)
F21V 29/70	(2015.01)
F21K 99/00	(2010.01)
F21Y 101/02	(2006.01)
F21V 29/507	(2015.01)
F21V 29/83	(2015.01)

(52) **U.S. Cl.**
CPC . ***F21V 29/02*** (2013.01); ***F21K 9/13*** (2013.01); *F21K 9/90* (2013.01); *F21V 29/507* (2015.01); *F21V 29/83* (2015.01); *F21Y 2101/02* (2013.01); *Y10T 29/49117* (2015.01)

(58) **Field of Classification Search**
CPC H01J 61/52; F21V 29/00; F21V 29/02; F21V 29/22; F21V 29/025; F21V 29/027; F21V 29/2293; F24F 3/056; F24F 13/078; G03B 21/16; F21K 9/135; H05B 33/00
USPC 315/112–113, 117; 362/218, 264, 294, 362/345, 373
See application file for complete search history.

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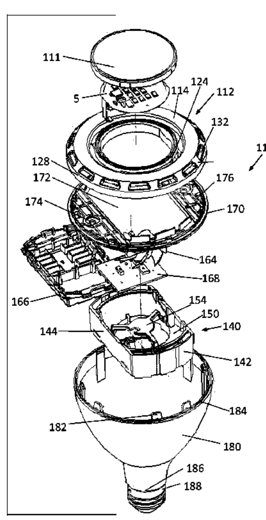
Primary Examiner — Tuyet Vo
Assistant Examiner — Henry Luong
(74) *Attorney, Agent, or Firm* — Booth Udall Fuller, PLC

(57) **ABSTRACT**

A light emitting diode (LED) system that includes a LED, a heat sink, a fan housing, a fan, and a cover is disclosed. The heat sink is typically coupled to the LED, and the fan housing is typically coupled to the heat sink opposite the LED. The fan housing is sized to fit within an electrical junction box and includes a fan housing aperture that extends through the fan housing. A cover may be coupled to the fan housing opposite the heat sink. The system may include at least one air intake opening and at least one air exhaust opening. When activated, the fan may external air into the fan housing through the air intake opening and direct the air toward the heat sink and ultimately through the air exhaust opening. In so doing, the temperature of the heat sink and the LED is reduced.

23 Claims, 30 Drawing Sheets



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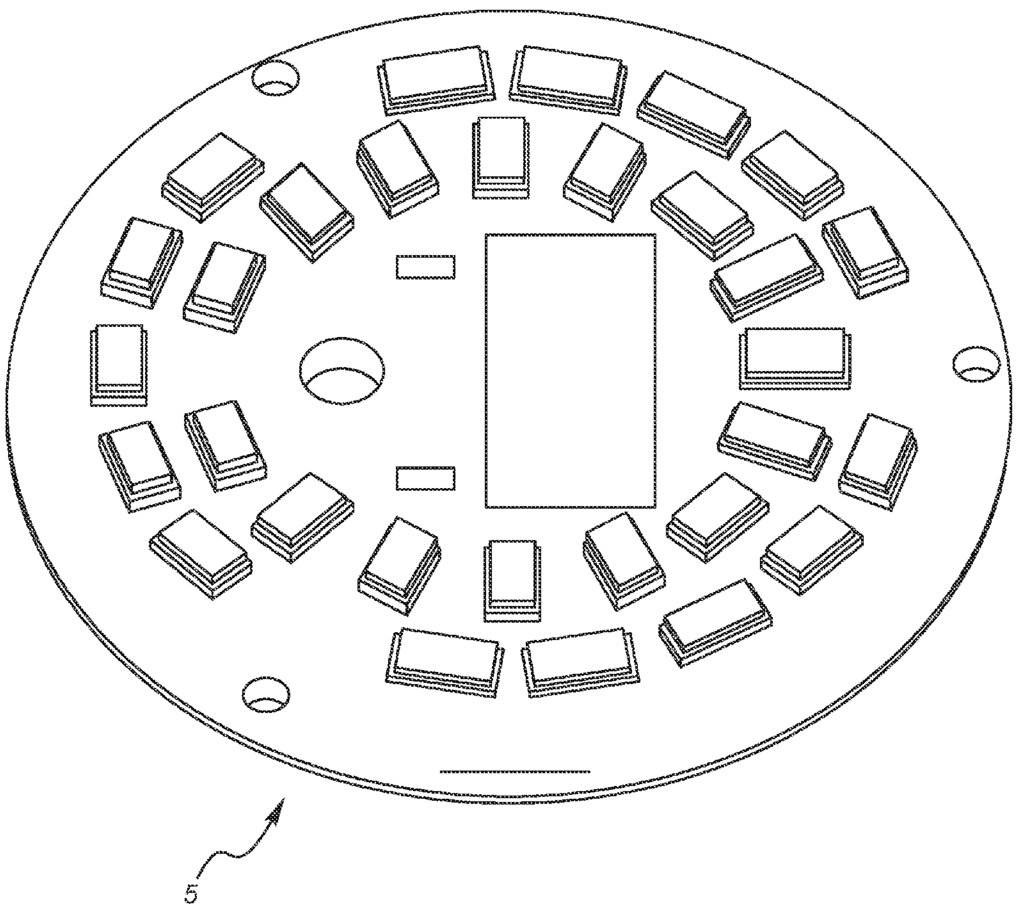

FIG. 1

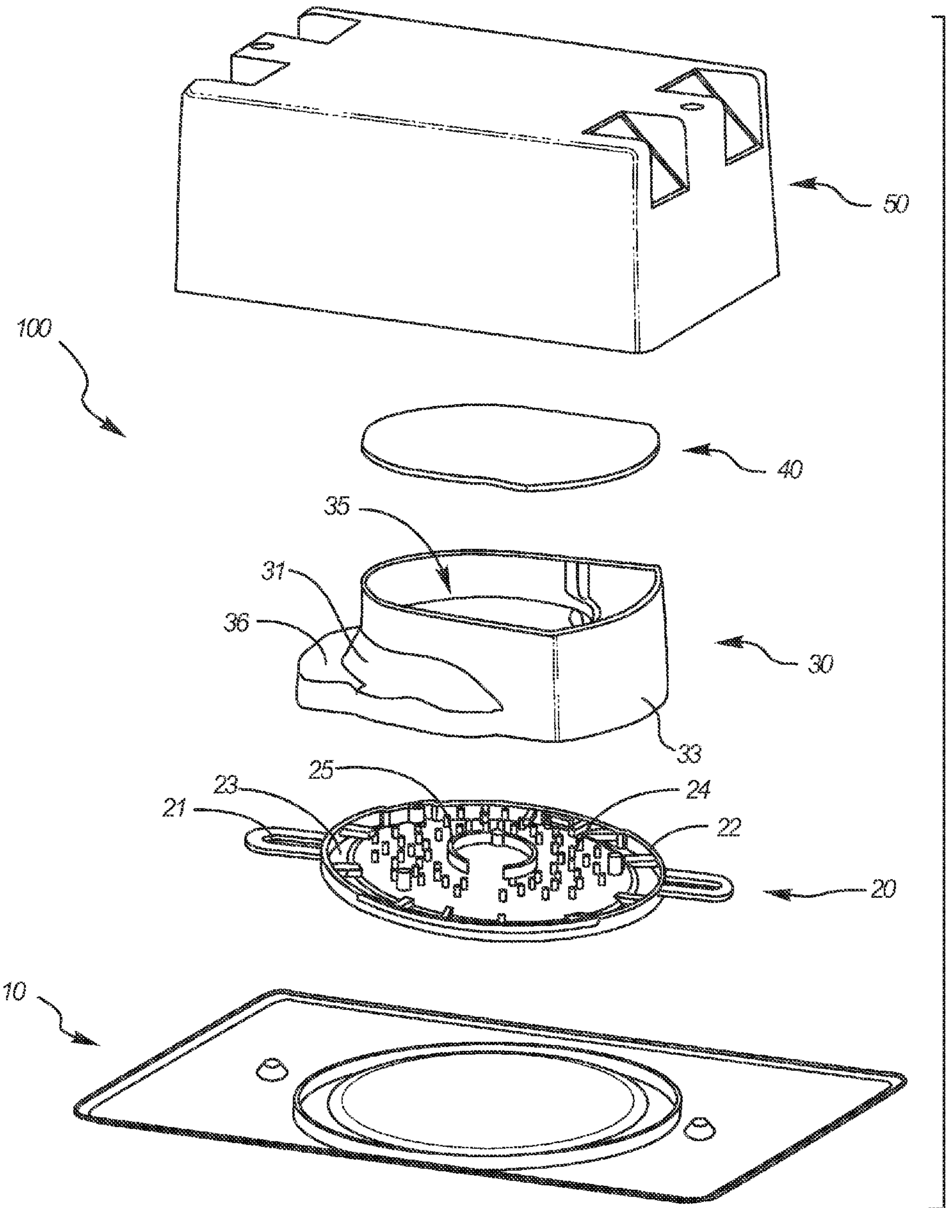

FIG. 2

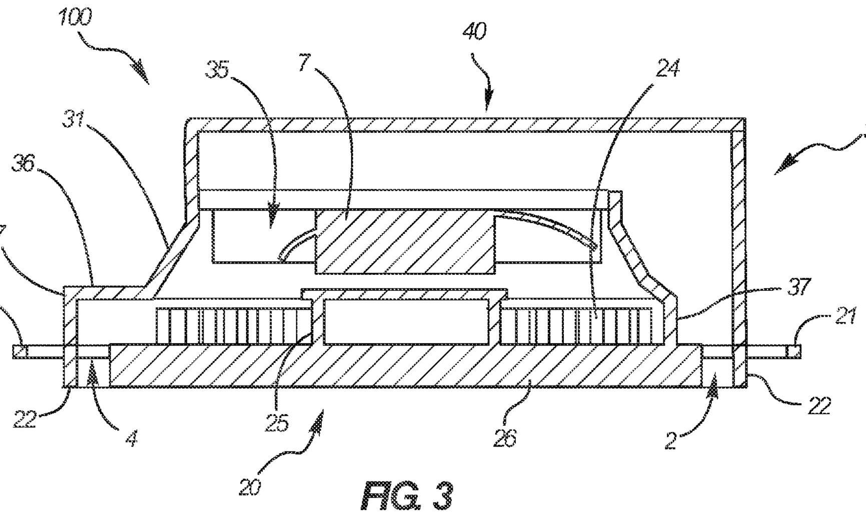
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FIG. 3

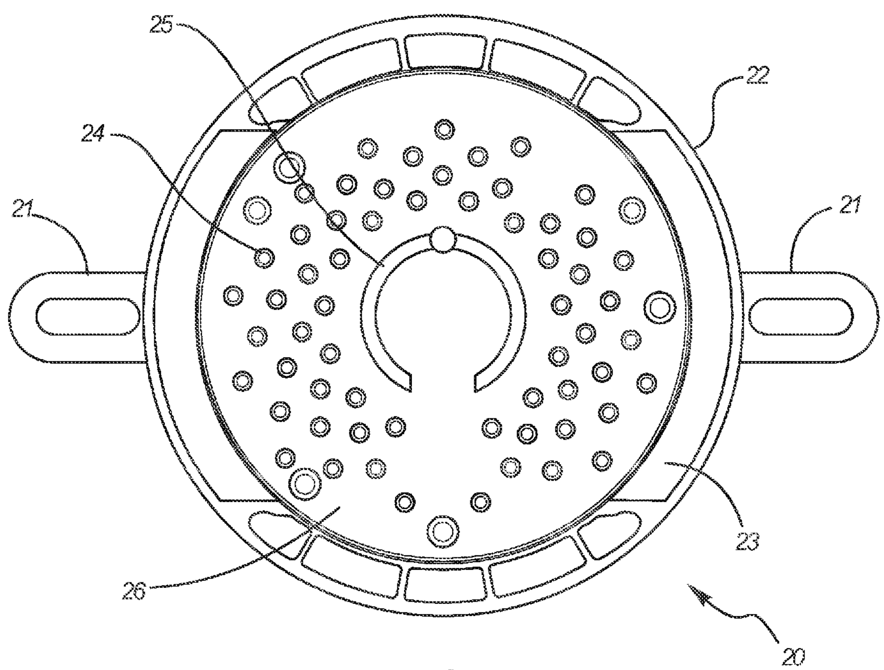
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FIG. 4

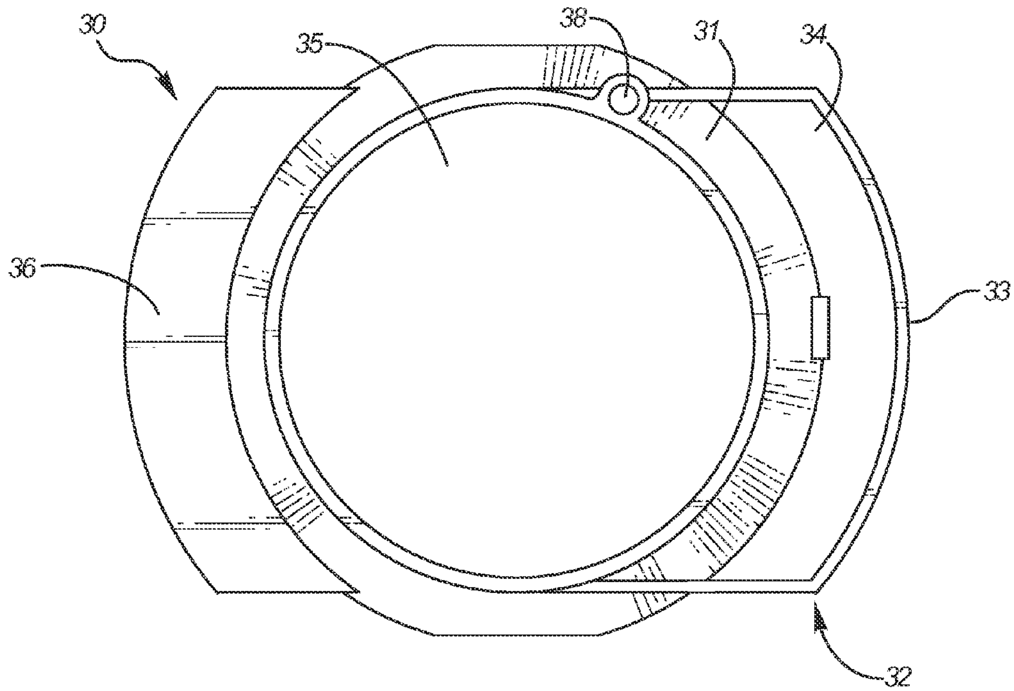


FIG. 5A

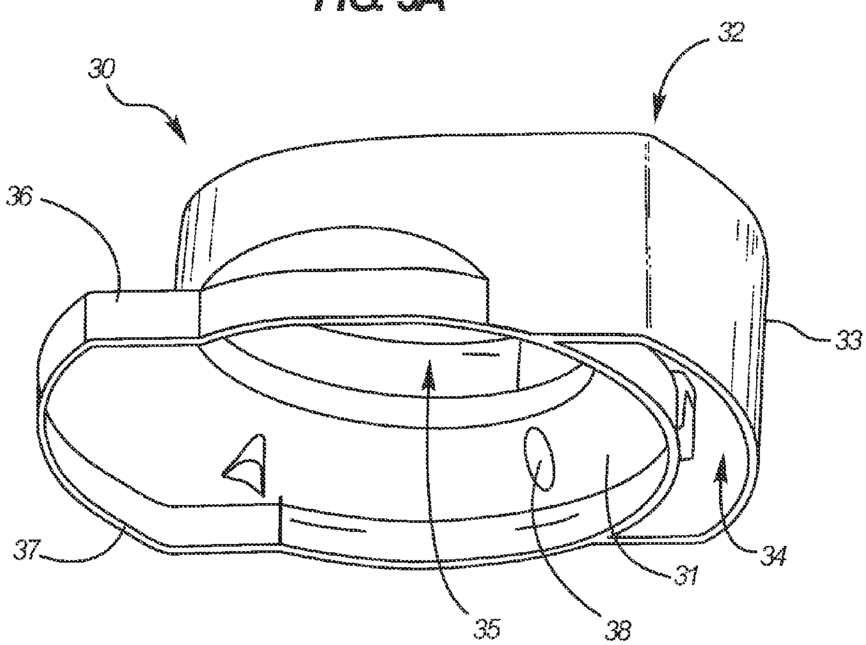
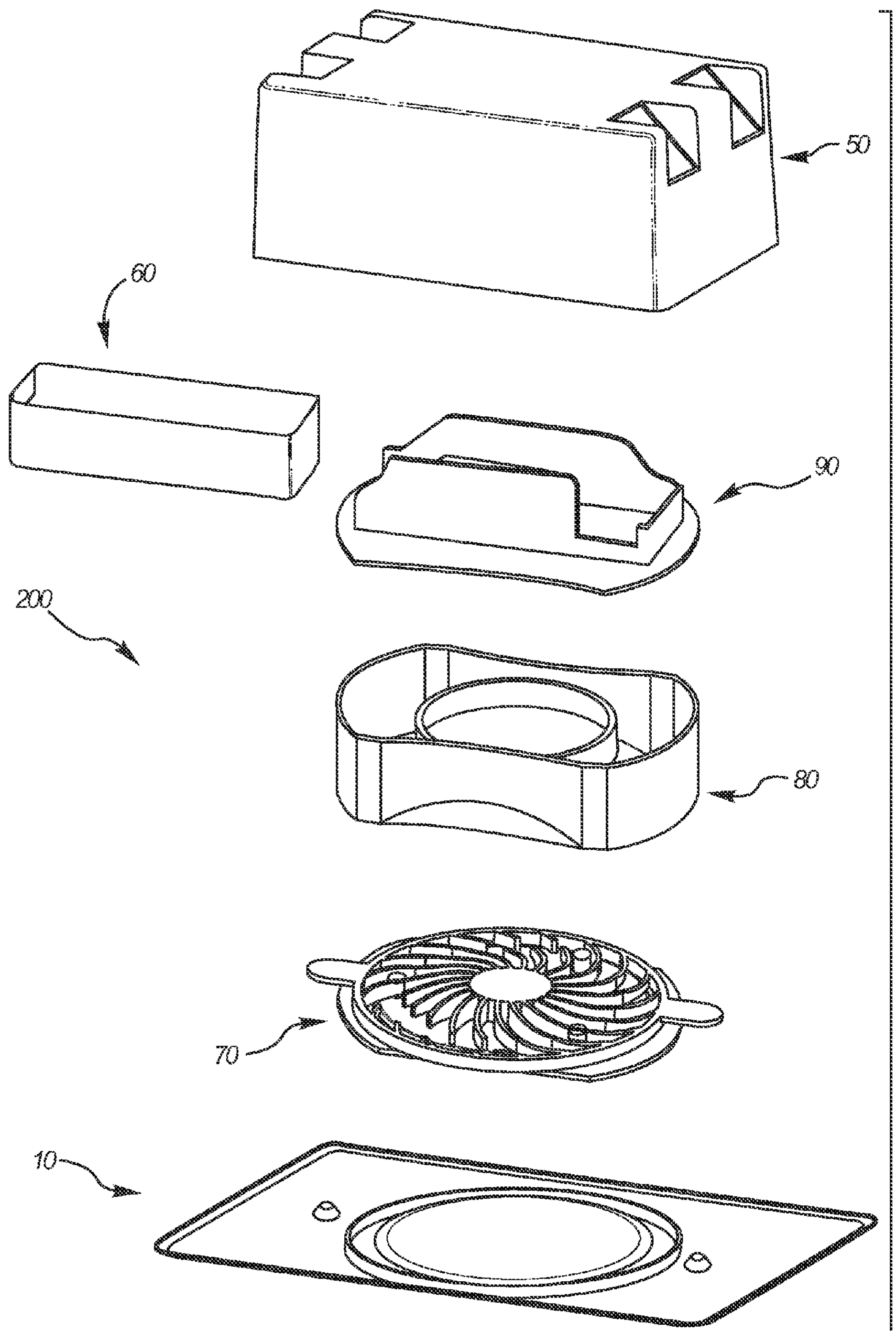


FIG. 5B



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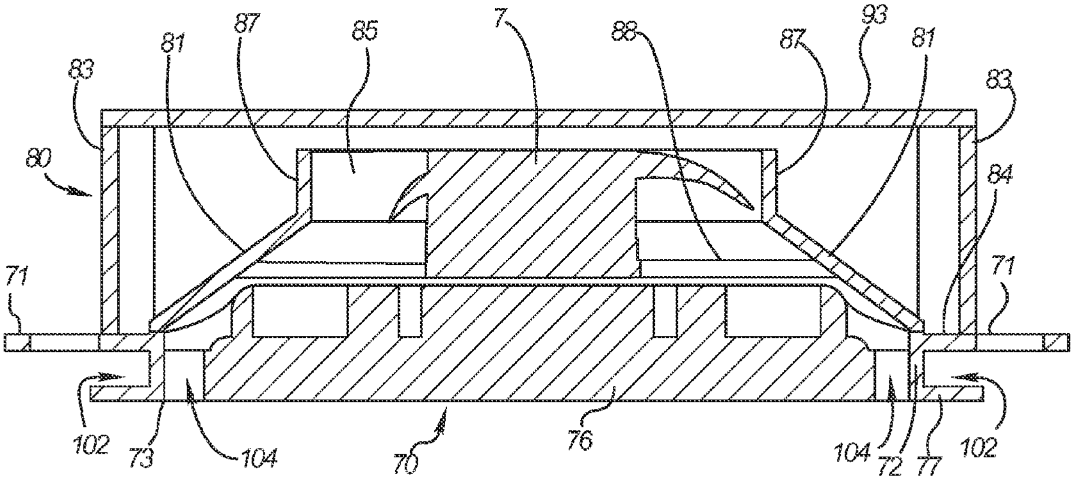
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FIG. 7

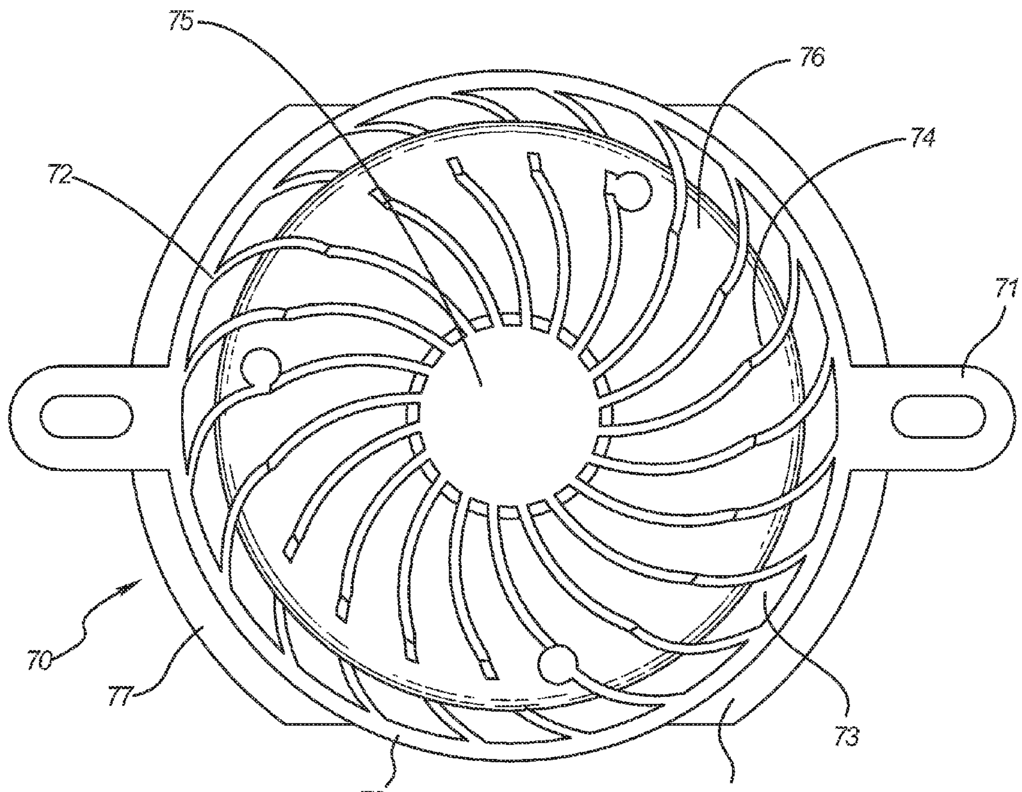
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FIG. 8

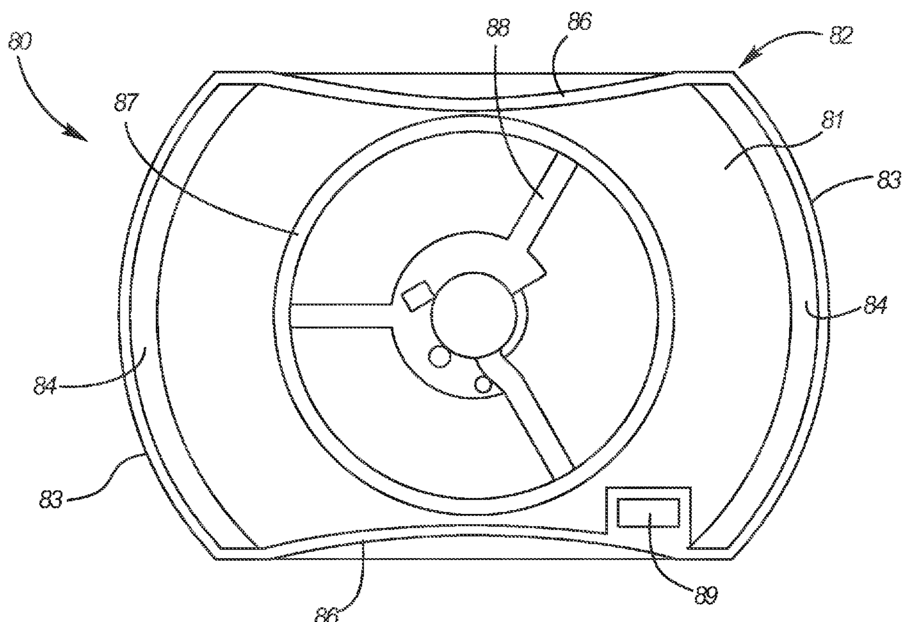
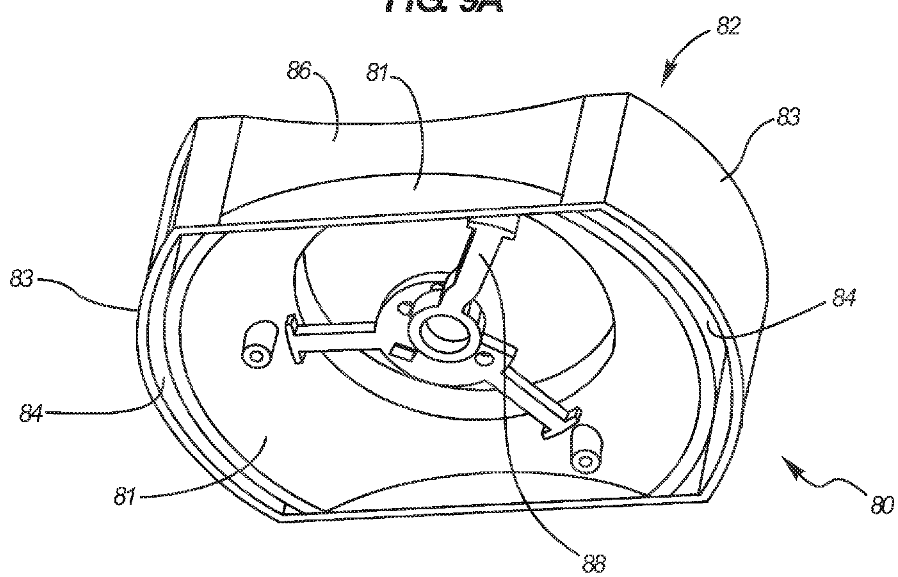


FIG. 9A



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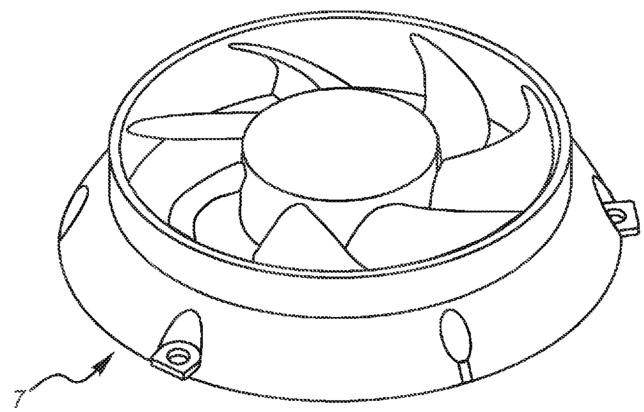

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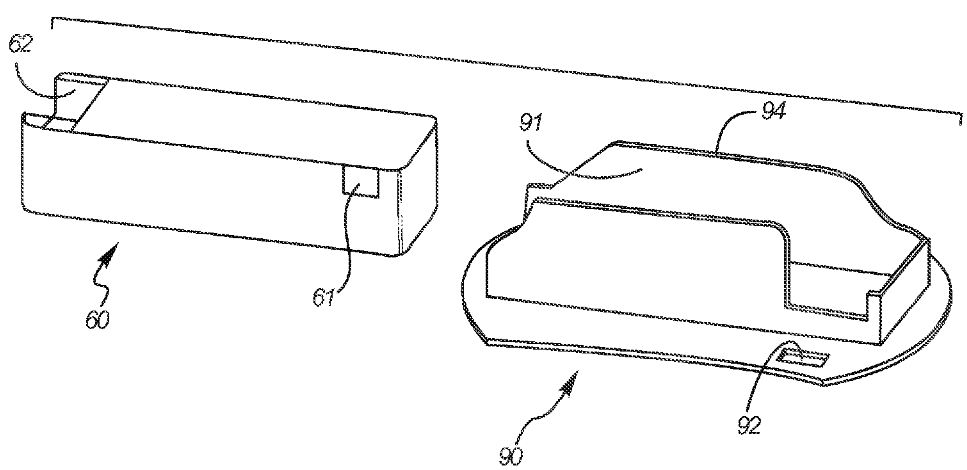

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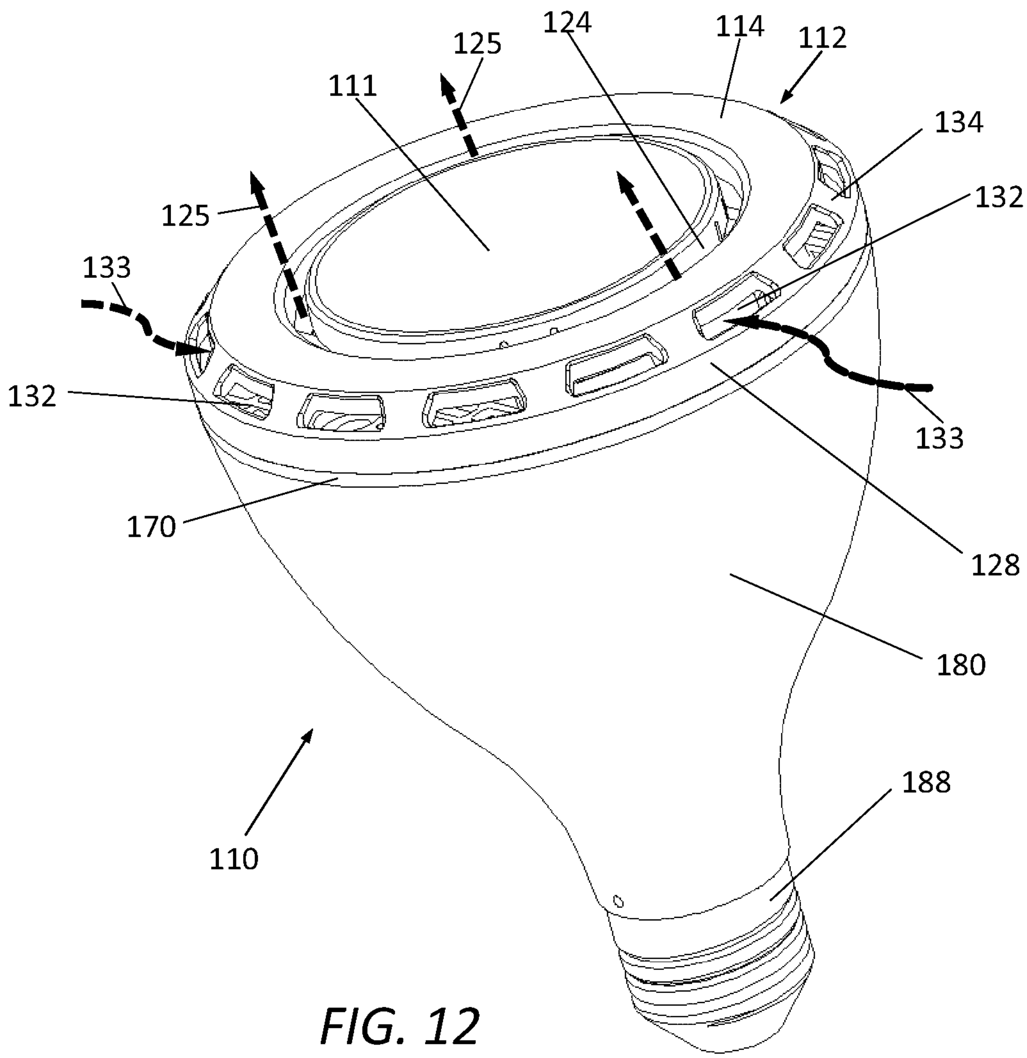

FIG. 12

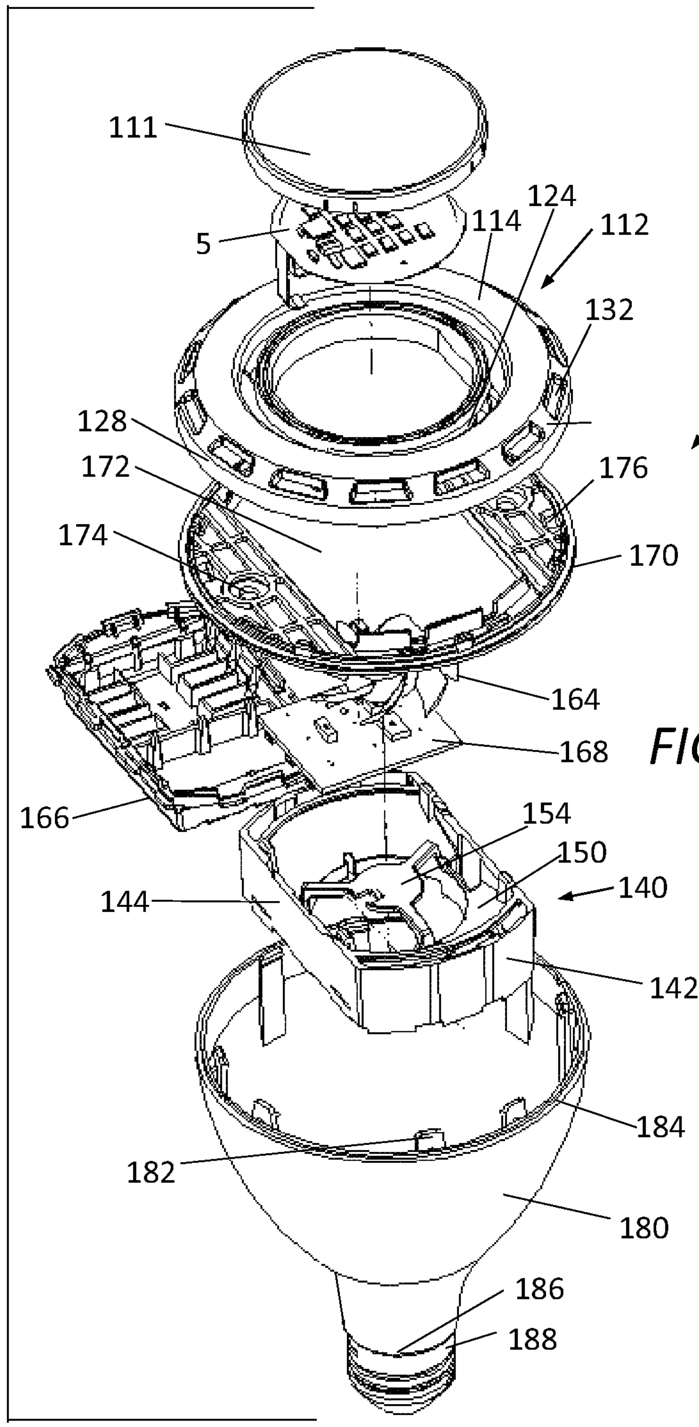
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FIG. 13

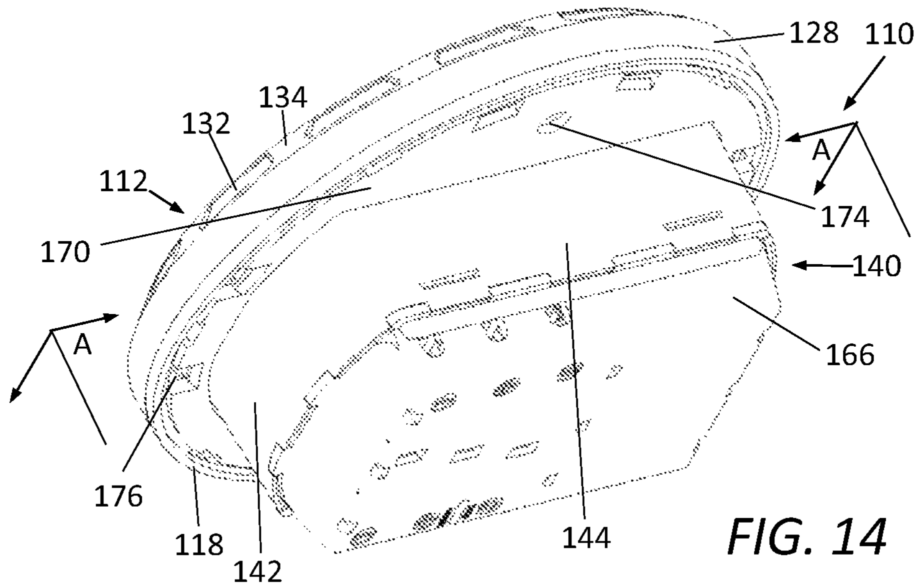
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FIG. 14

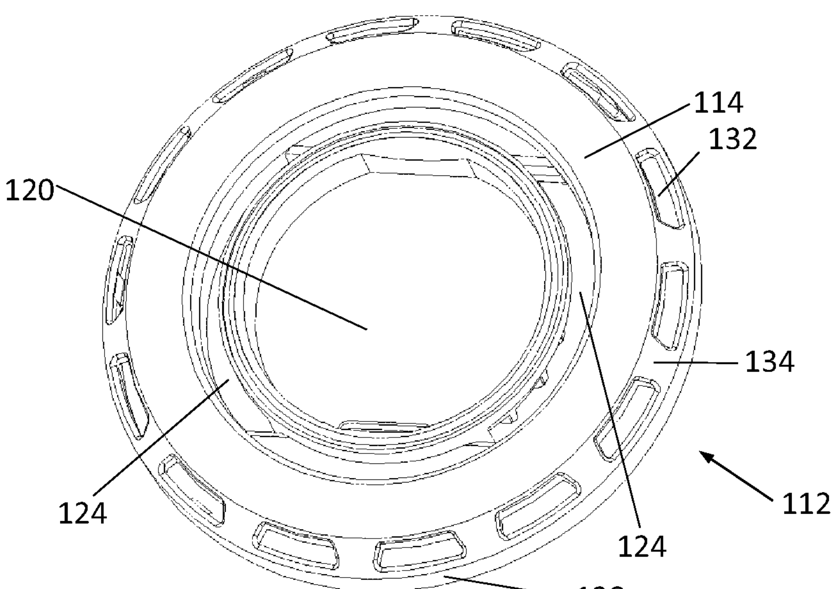
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FIG. 15

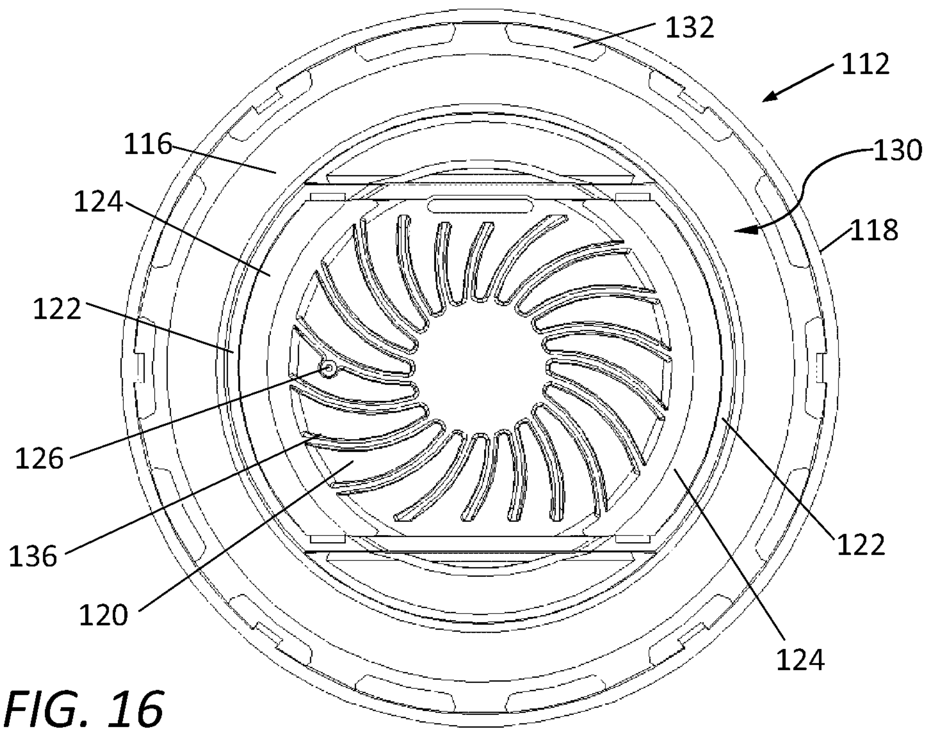
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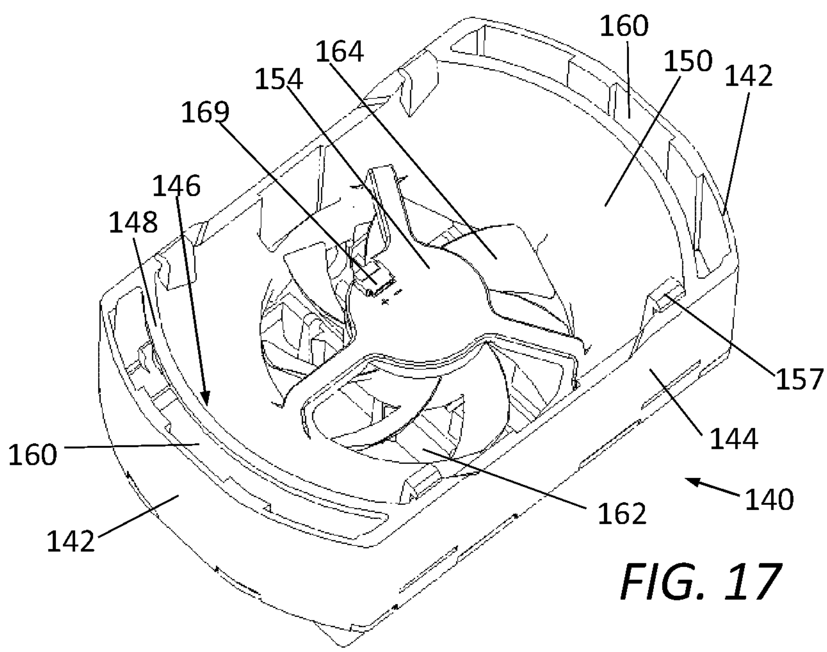
FIG. 16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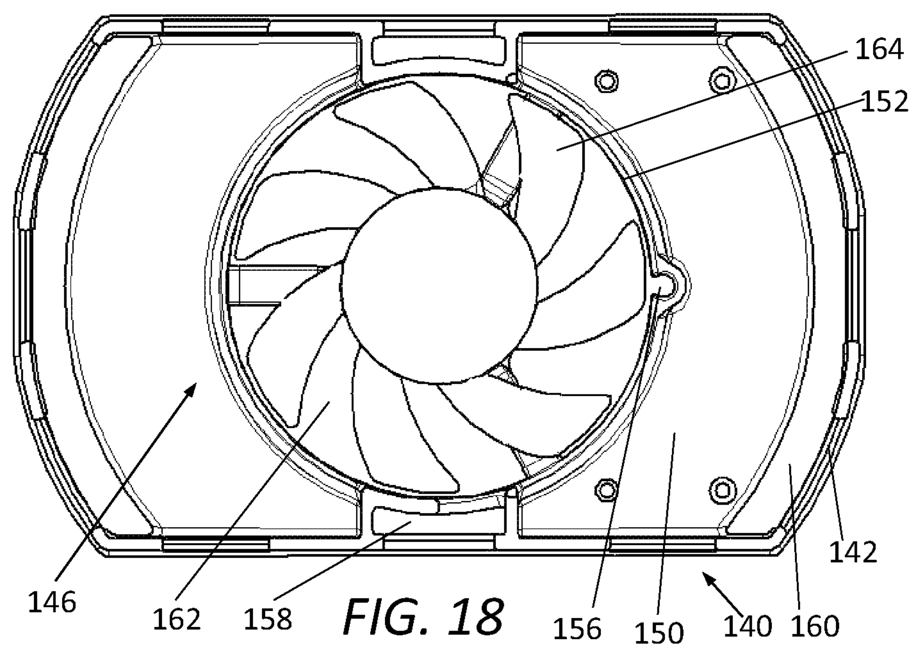

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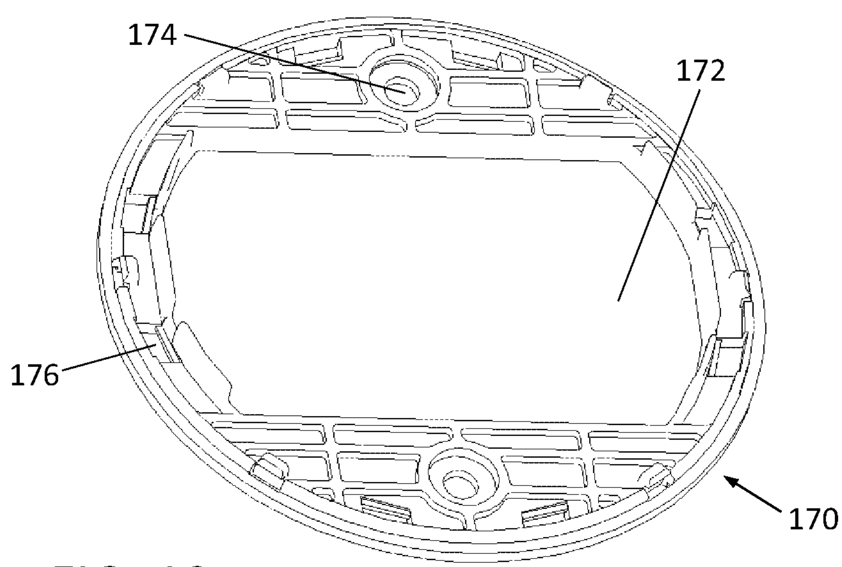

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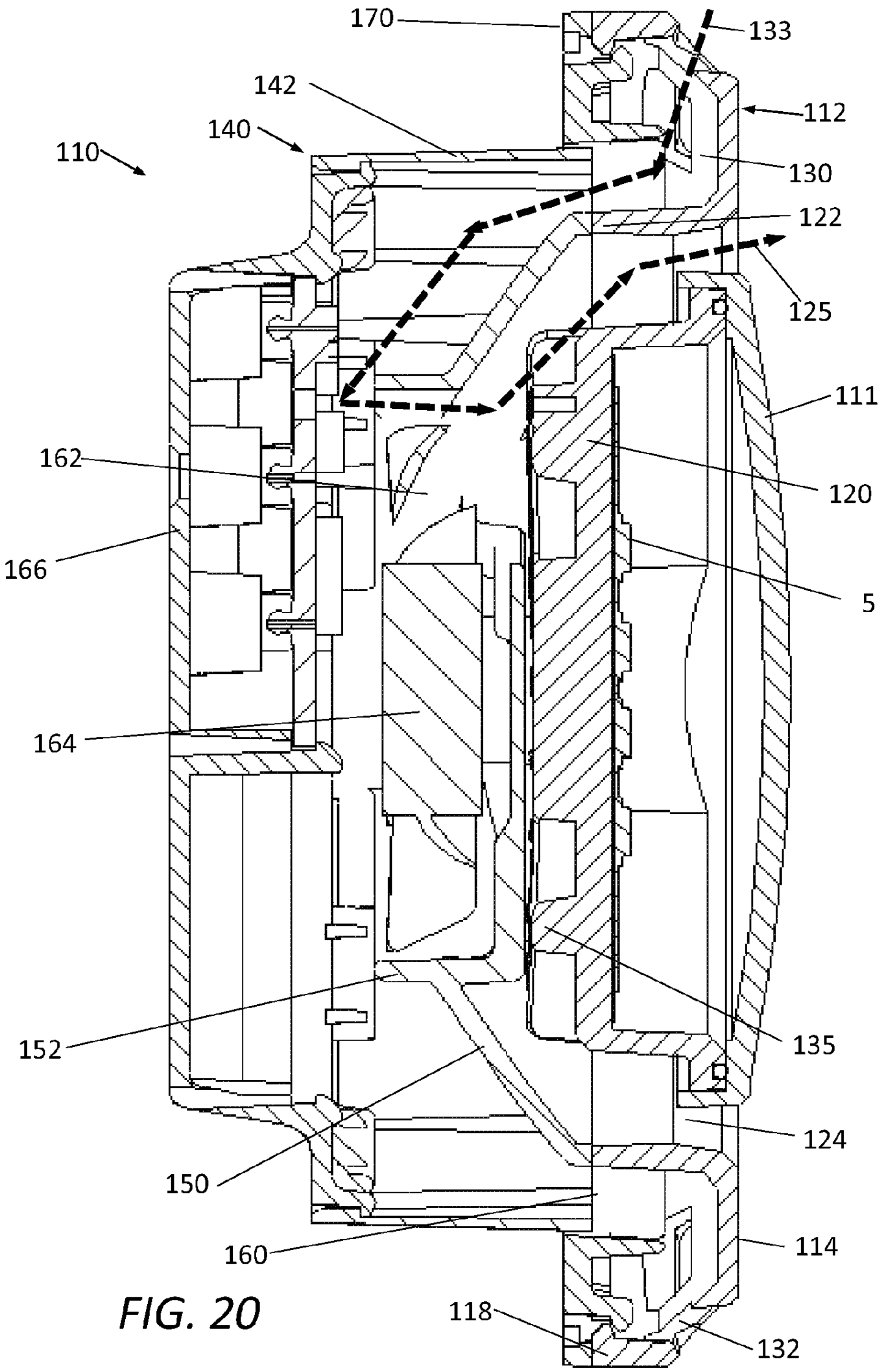
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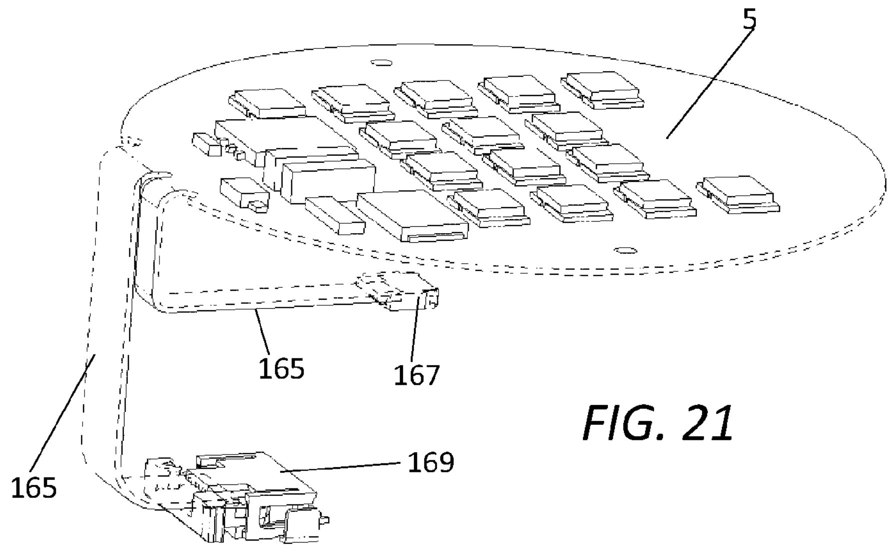
FIG. 20



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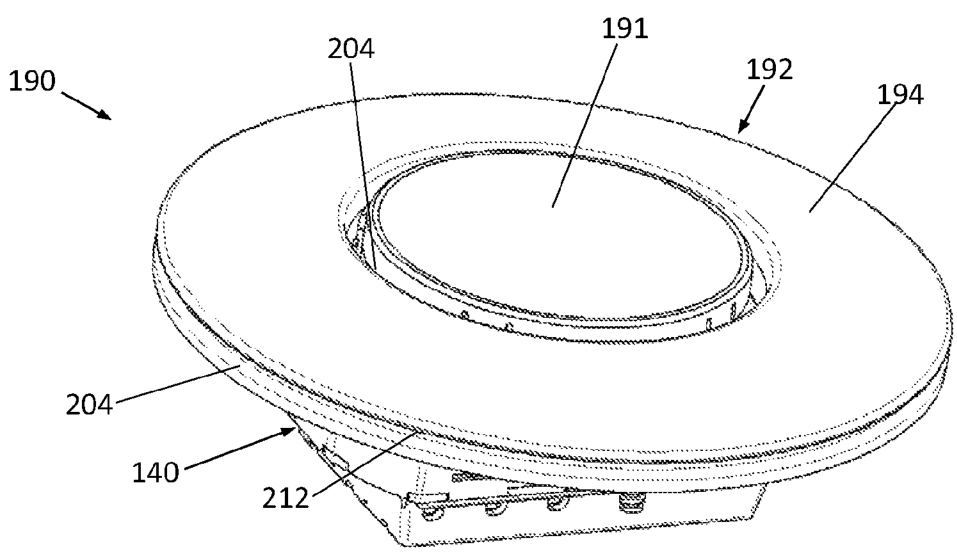

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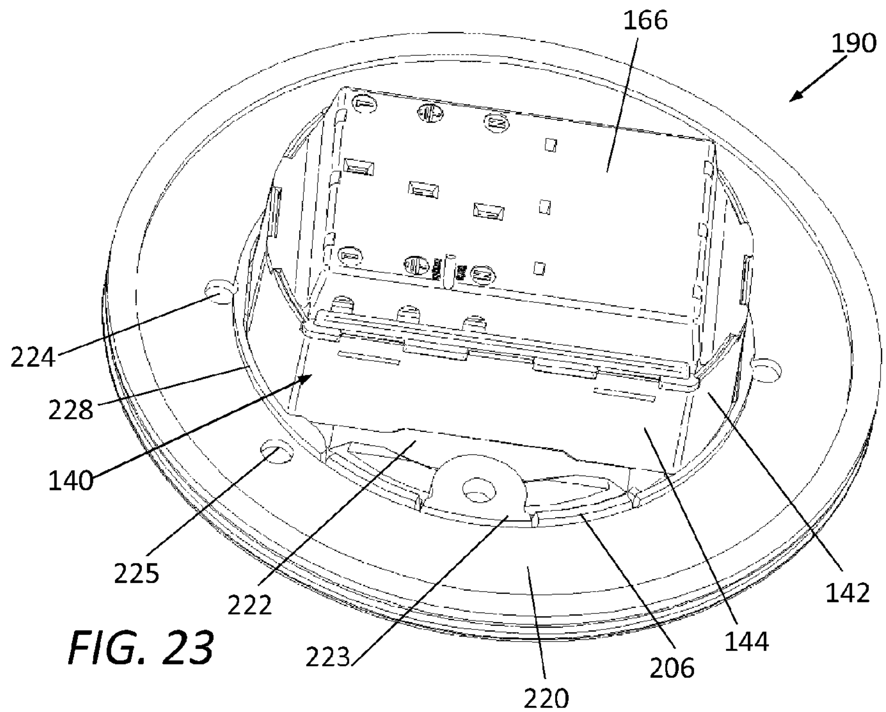
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FIG. 23

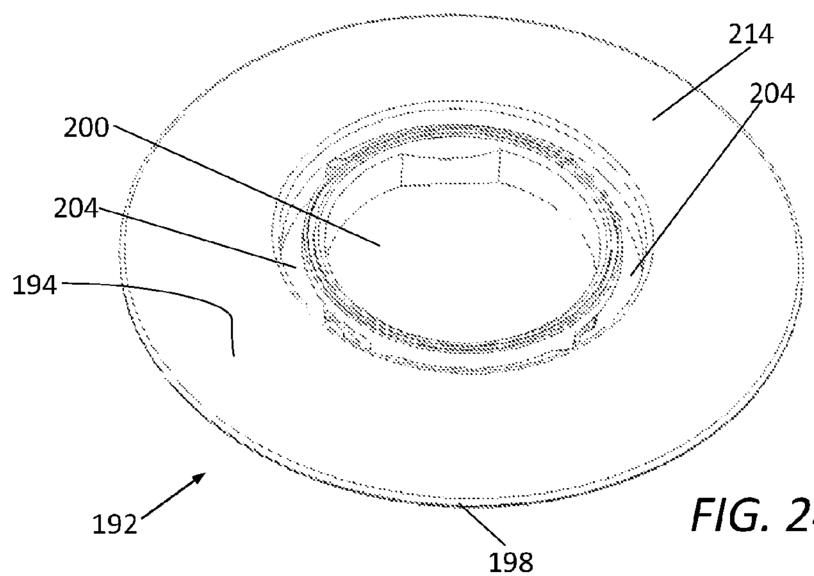
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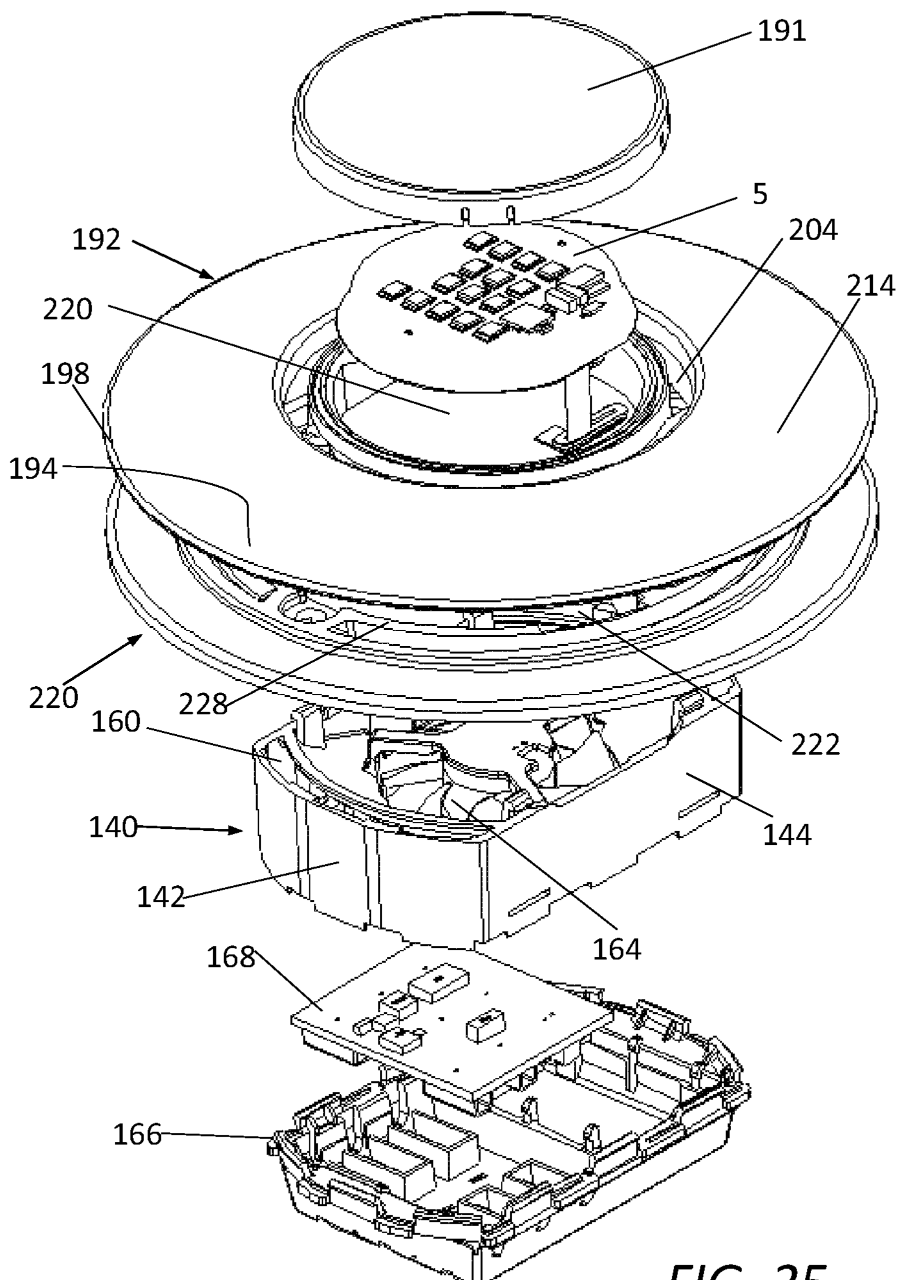
FIG. 24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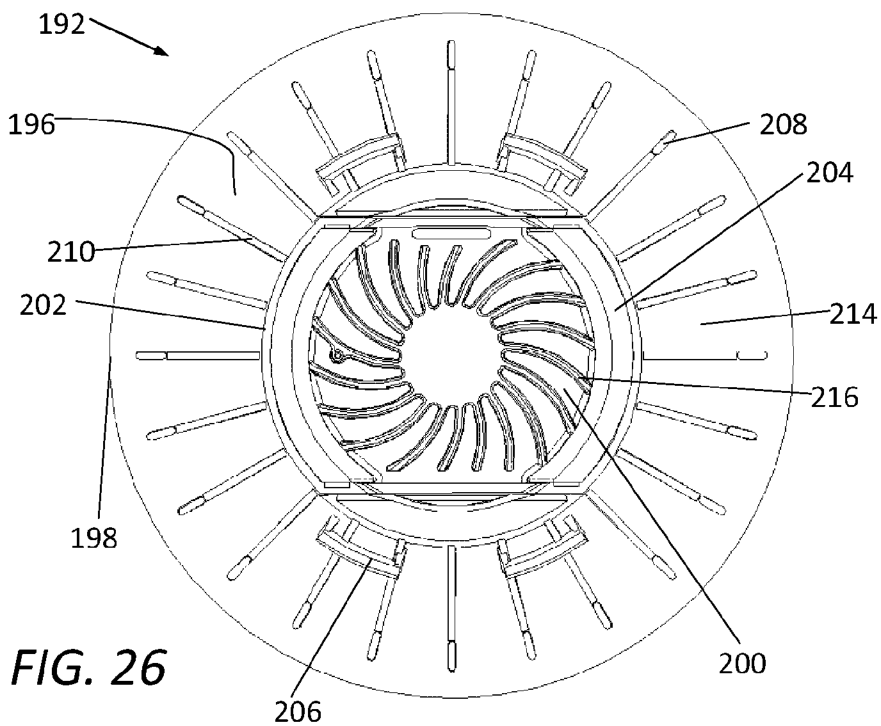
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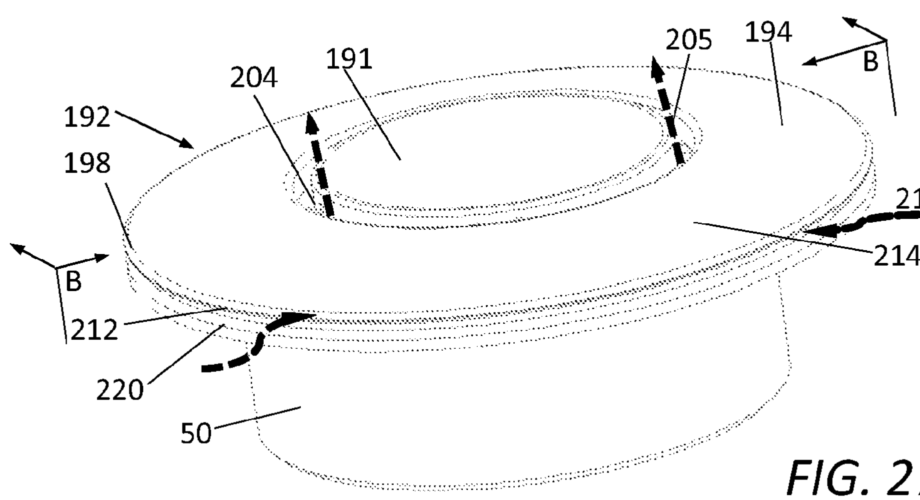
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FIG. 27

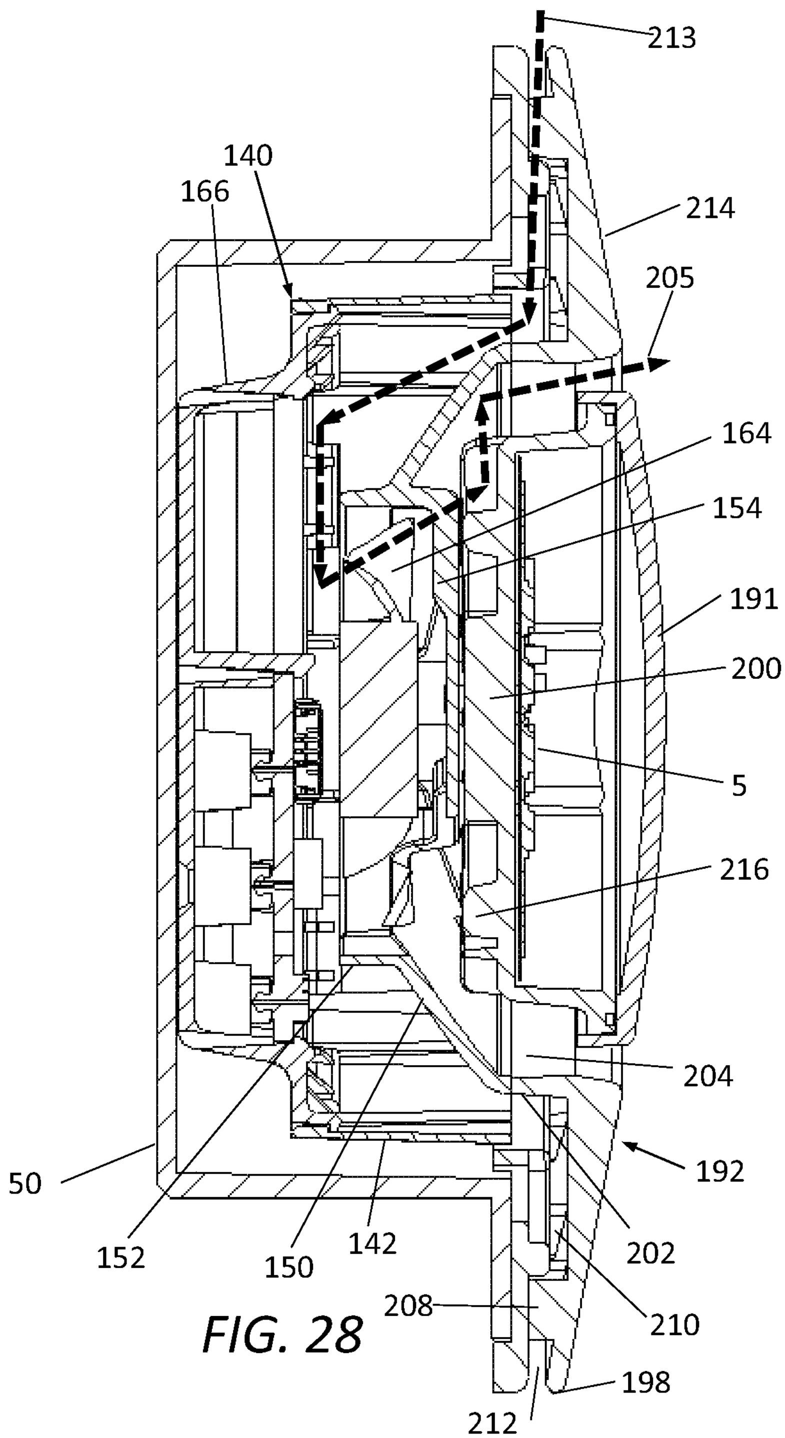
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FIG. 28

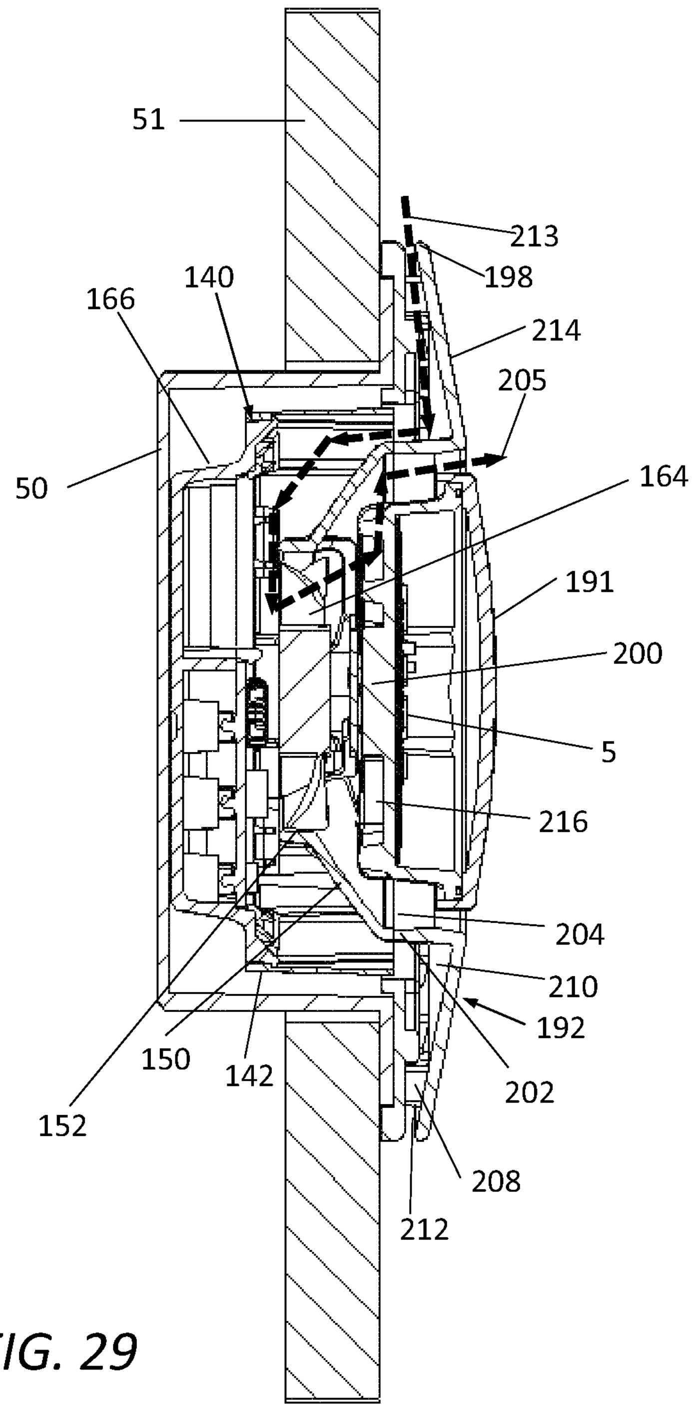
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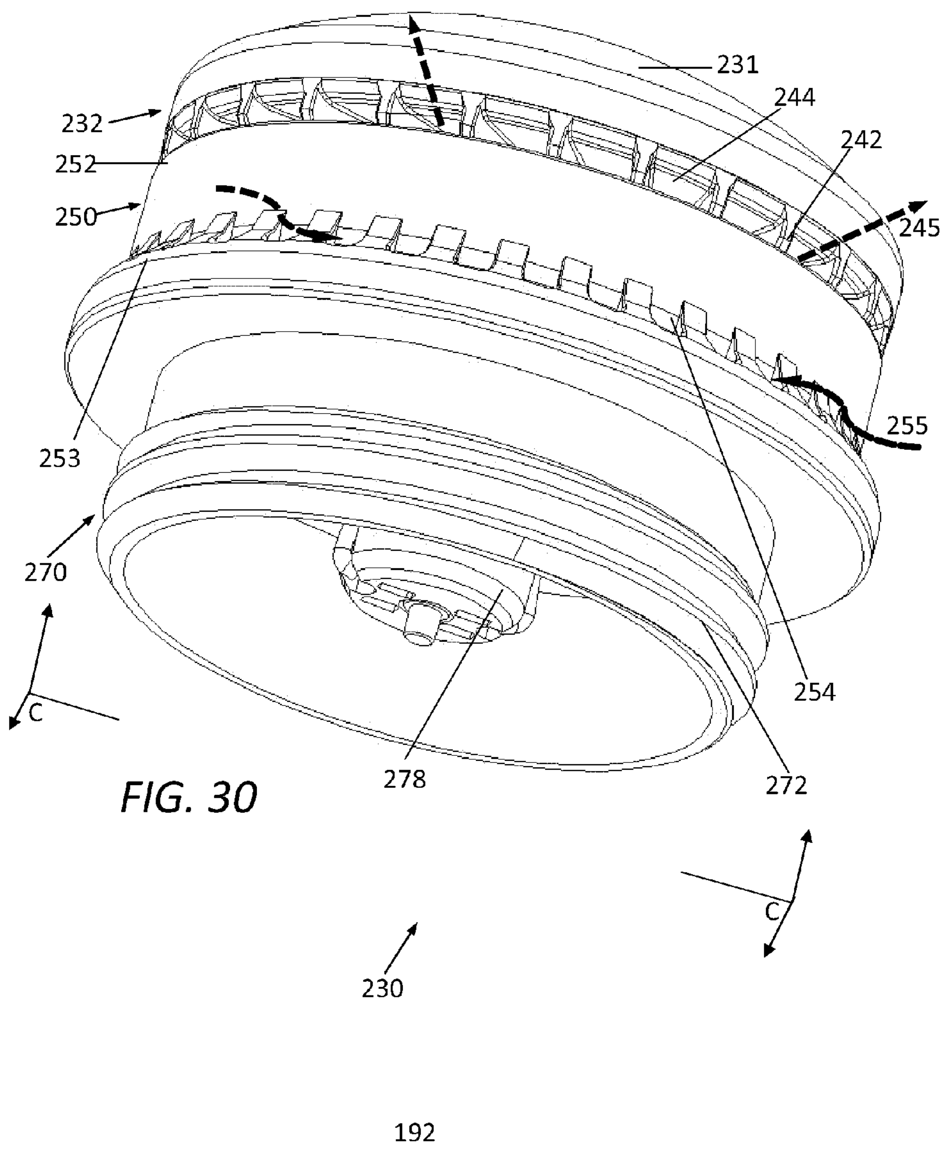
FIG. 29



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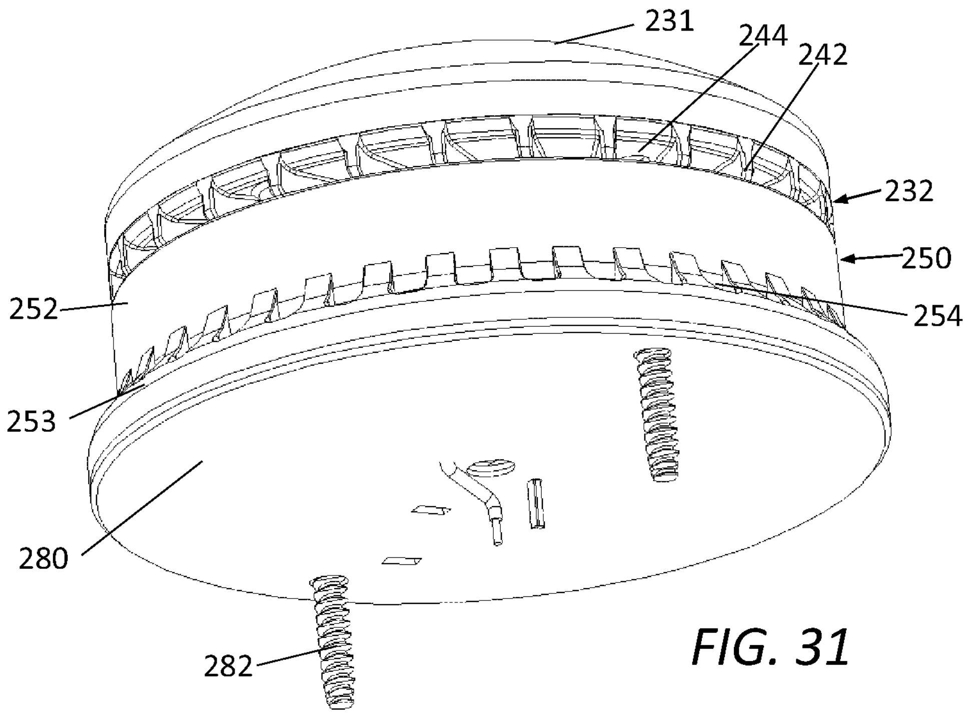
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FIG. 31

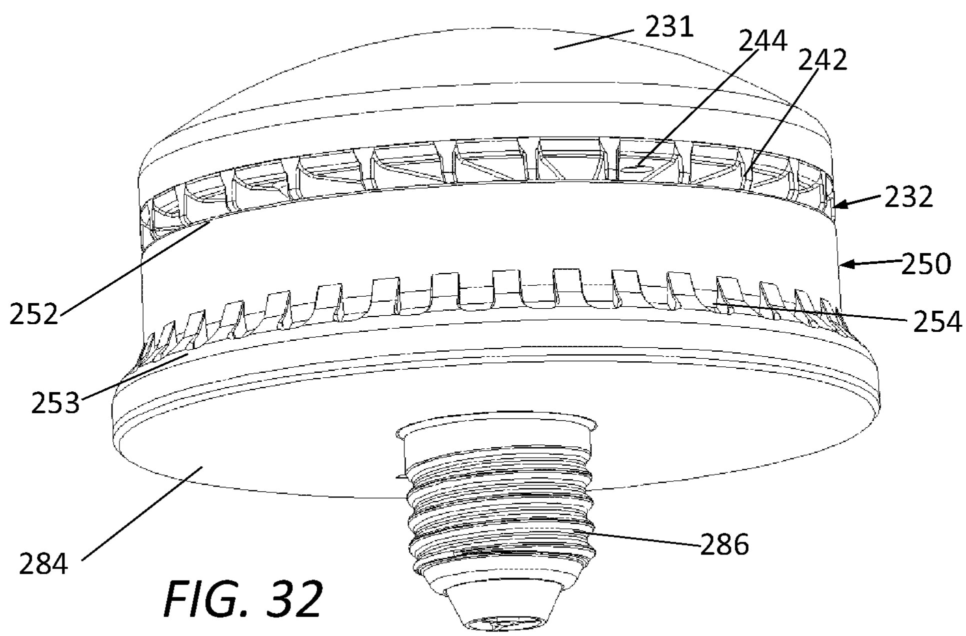
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FIG. 32

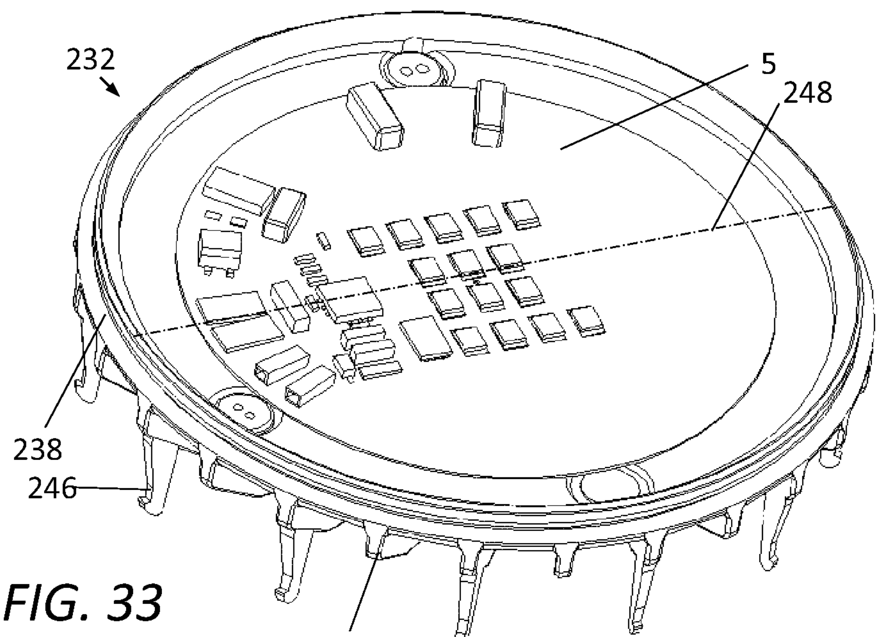

FIG. 33

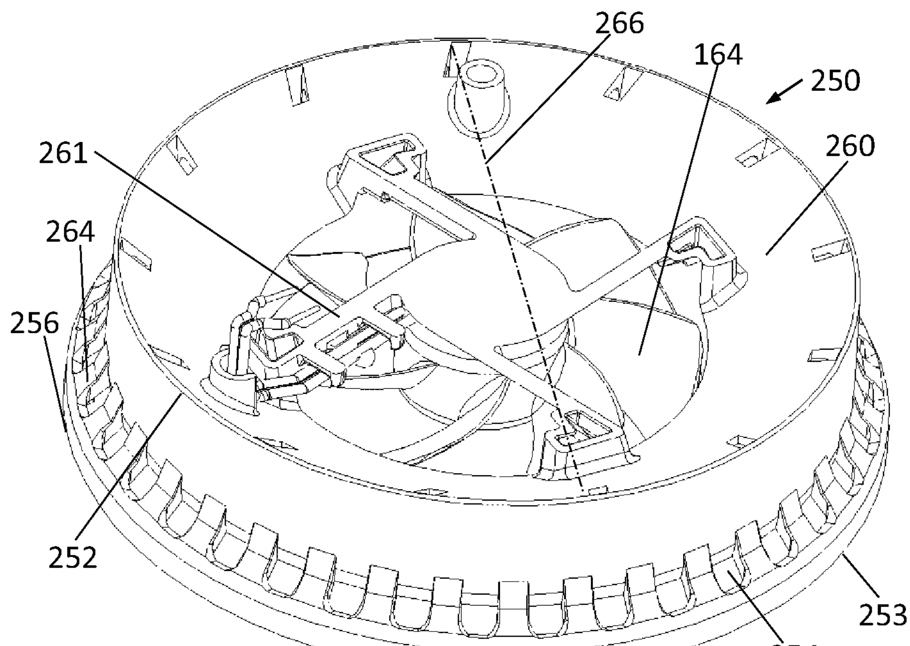

FIG. 34

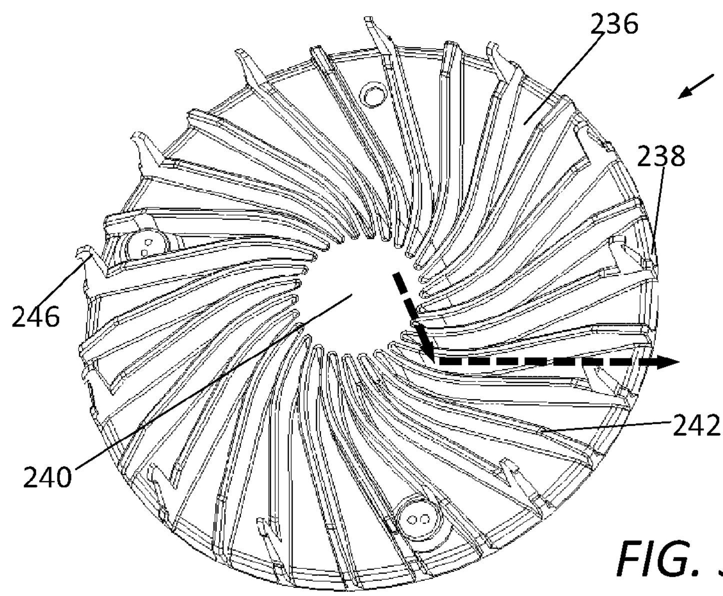
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FIG. 35

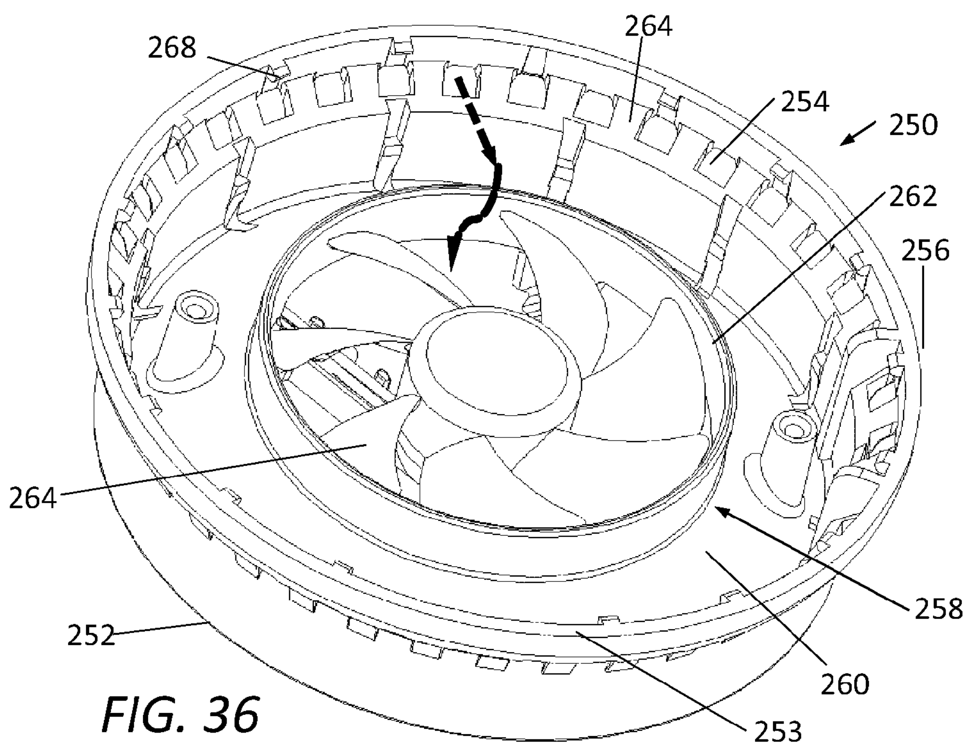
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FIG. 36

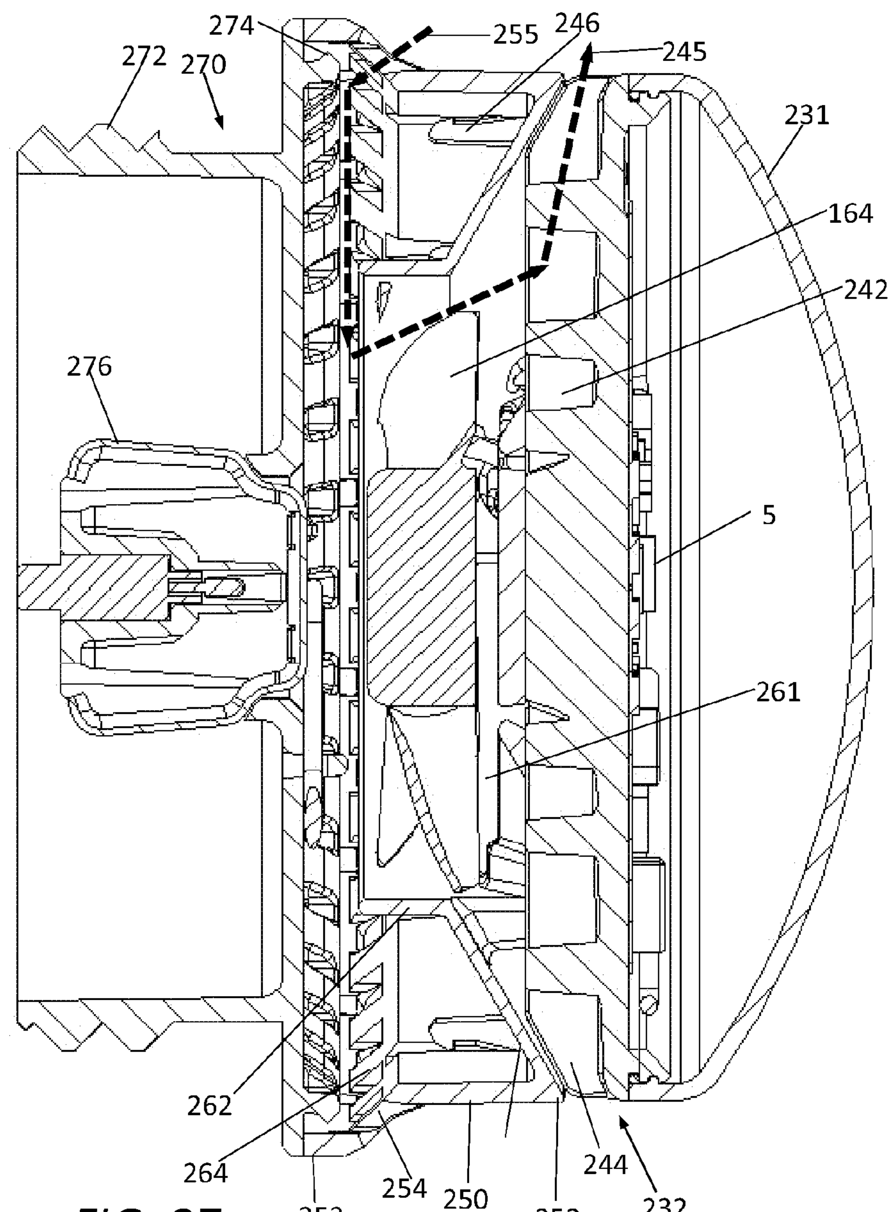
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FIG. 37

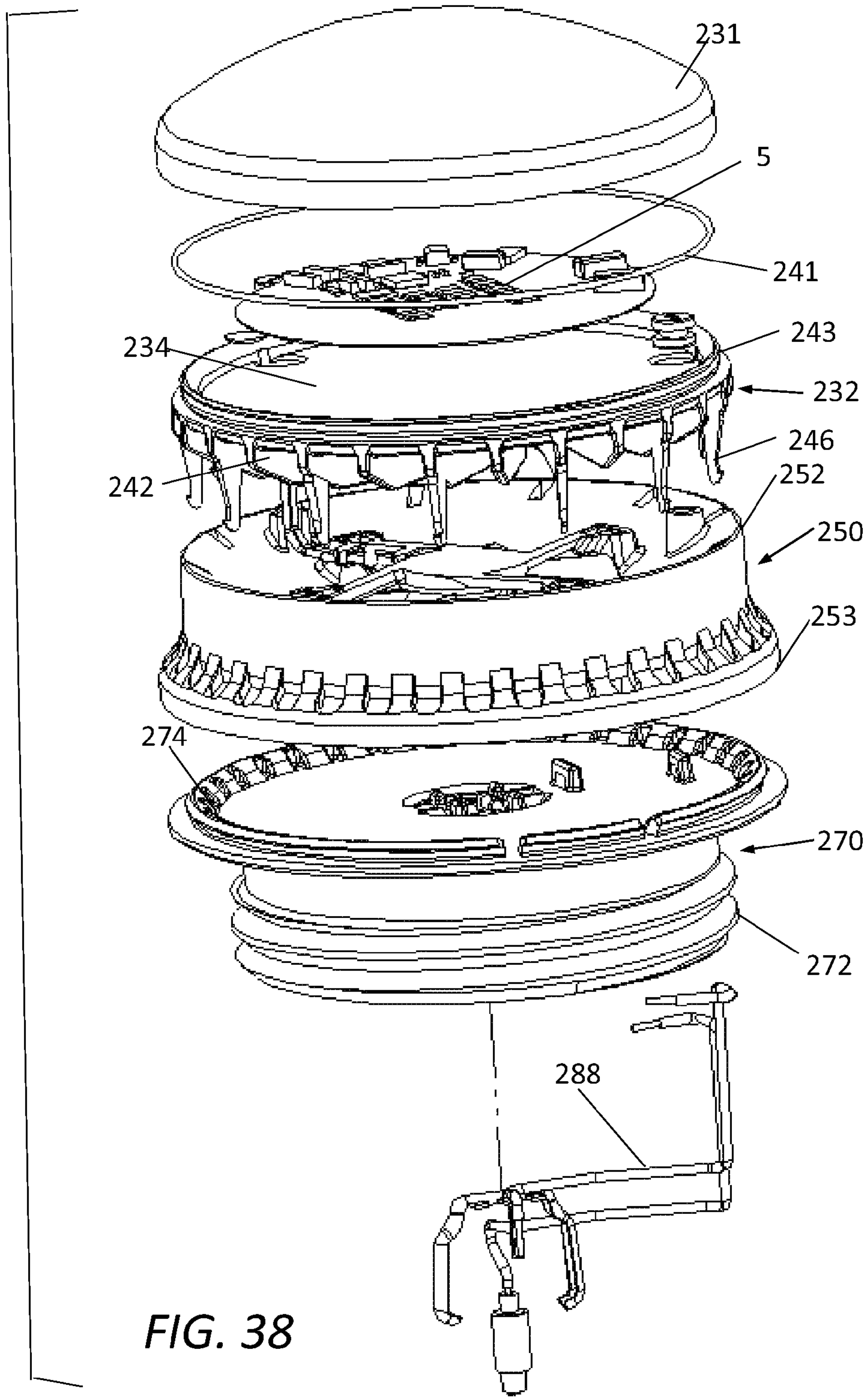


FIG. 38

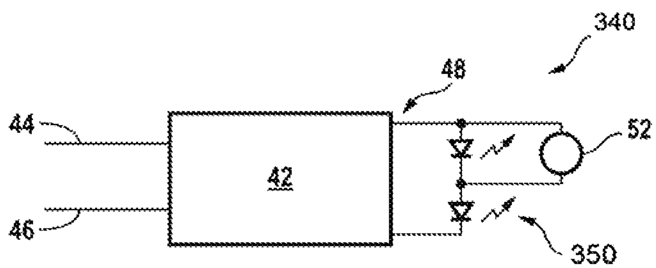


FIG. 39A

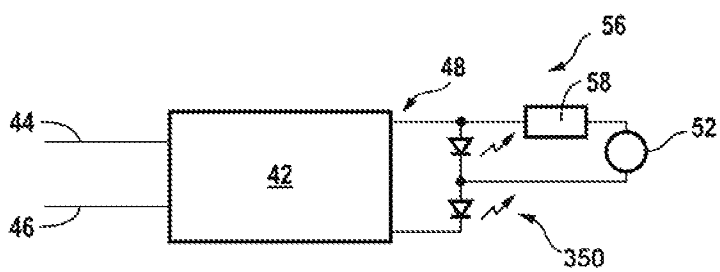
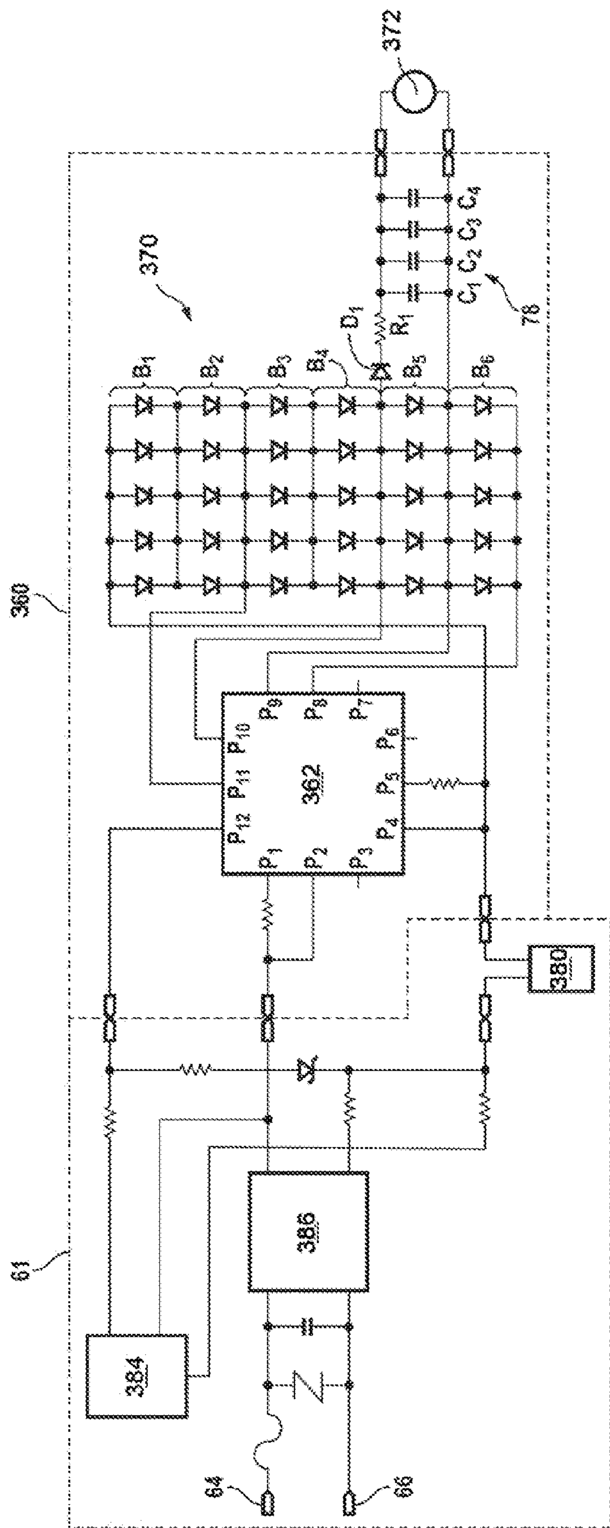


FIG. 39B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P_1 P_2 P_3 P_4 P_5 P_6 P_7 P_8 P_9 P_{10} P_{11} P_{12}
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FIG. 40

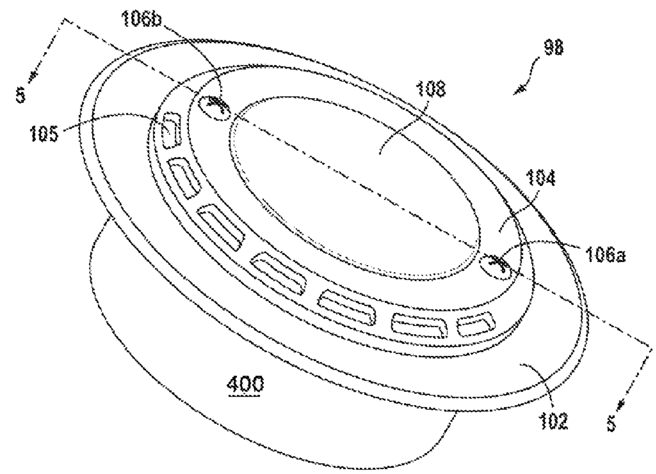
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FIG. 41

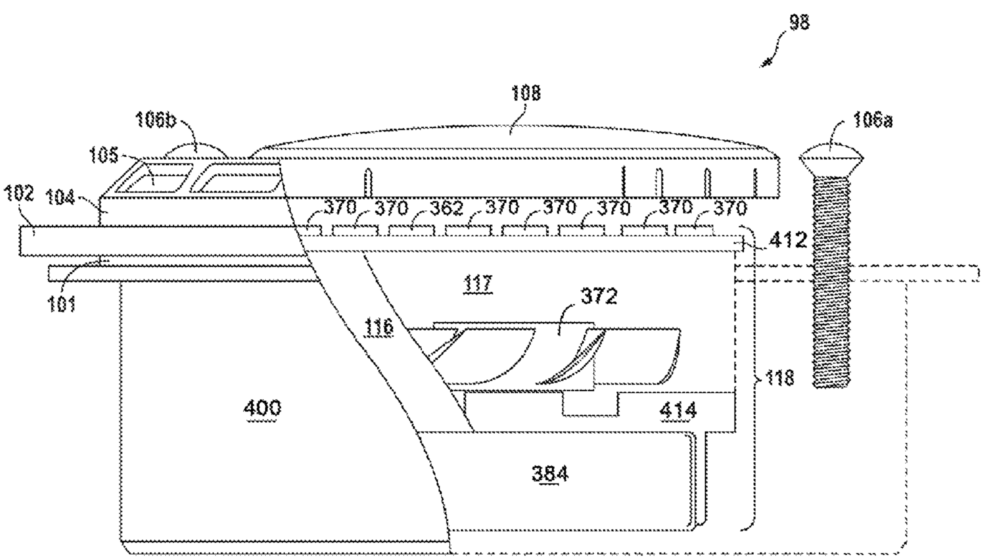
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FIG. 42

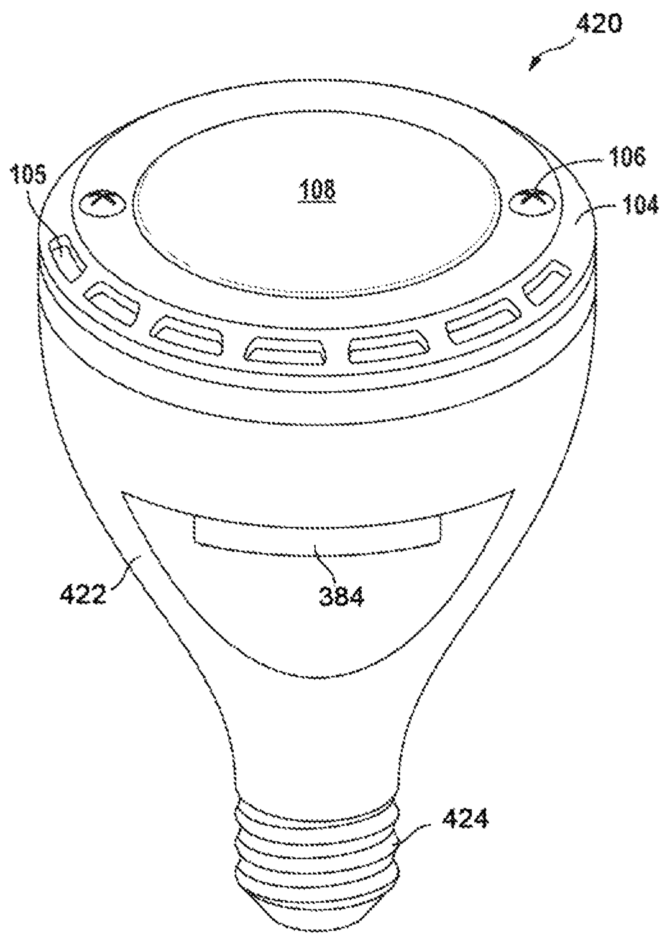

FIG. 43

FAN COOLED LED LIGHT AND HOUSING

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 14/327,341 entitled "FAN COOLED LED LIGHT AND HOUSING" to Clifford, which was filed on Jul. 9, 2014, now pending, which is a continuation-in-part of U.S. patent application Ser. No. 13/938,093 entitled "COMPACT LED DEVICE WITH COOLING FAN" to Clifford, which was filed on Jul. 9, 2013, which is a continuation-in-part application of U.S. patent application Ser. No. 13/908,690 entitled FAN COOLED LED LIGHT AND HOUSING" to Clifford, which was filed on Jun. 3, 2013, the contents of all of which hereby incorporated by this reference.

BACKGROUND

1. Technical Field

Aspects of this document relate generally to light emitting diode assemblies.

2. Background Art

Light-emitting diodes (LED) are becoming an increasingly popular light source. Generally, LEDs are advantageous to typical incandescent light sources due to LEDs' lower energy consumption, longer lifetime, smaller size, and faster switching. The efficiency and operational life of LEDs, however, is somewhat limited by the heat generated by LEDs with the LEDs activated.

SUMMARY

According to one aspect, a light emitting diode (LED) lighting system comprises one or more LEDs, a heat sink coupled to the one or more LEDs, a fan housing, and a fan. The heat sink comprises an outer periphery, a platform, a sink wall, and an air exhaust opening extending through the platform and positioned between the sink wall and the platform. The fan housing is coupled to the platform of the heat sink opposite the one or more LEDs and comprises an end wall positioned between the sink wall and the outer periphery of the heat sink, a dividing wall coupled to the end wall and comprising a terminating end aligned with and adjacent to the sink wall, an outer opening positioned between the end wall and the dividing wall, a fan housing aperture within the fan housing, and a cover coupled to the positioned opposite the heat sink. The fan coupled to the fan housing is positioned at least partially within the fan housing aperture, wherein airflow enters the fan housing through the outer opening, passes through the fan housing aperture to interface the heat sink, and exits through the air exhaust opening responsive to activation of the fan.

Various implementations and embodiments may comprise one or more of the following. The sink wall may comprise two sink walls, the air exhaust openings may comprise two air exhaust openings extending through the platform, each air exhaust opening positioned between a different sink wall and the platform, the end wall of the fan housing may comprise two opposing end walls each positioned between a different sink wall of the two sink walls and the nearest outer periphery of the heat sink, the fan housing further comprising two opposing sidewalls positioned between the two end walls. The dividing wall of the fan housing may comprise two opposing dividing walls each comprising a terminating end aligned with and adjacent to a different one of the two sink walls, the fan housing aperture being positioned between the two dividing walls. The outer opening may comprise two outer openings positioned between a different end wall of the two end walls and a different dividing wall of the two dividing walls. The fan housing may include a height in a range between 2.5-6.875 centimeters and include a volume small enough to be housed within a standard single gang electrical junction box. The heat sink may be configured to mount to a flat surface and the end walls, the sidewalls, and the dividing walls of the fan housing are integral with one another. The heat sink may further comprise an outer wall at the outer periphery, a heat sink channel formed between the outer wall and each of the heat sink walls, and a plurality of air intake openings extending through the outer wall. The plurality of air intake openings may be positioned within an angled portion of the outer wall and the heat sink further comprises a plurality of arced ribs extending from the platform toward the fan housing. A bulb-like housing coupled to the heat sink such that the fan housing is housed within the bulb-like housing, the bulb like housing comprising an open first end coupled to the heat sink and a second end coupled to a socket fitting operably coupled to the one or more LEDs and the fan, wherein, responsive to activation of the fan, air flows into the LED light system through the air intake openings, through the two outer openings, through the fan housing aperture, and out the air exhaust openings, each air exhaust opening being separated from the air intake openings by at least the respective sink wall. A mounting ring removably coupled to the heat sink, the mounting ring comprising one or more screw holes positioned to align with one or more screw mounts on a standard electrical junction box such that when the mounting ring is coupled to the standard electrical junction box, the fan housing is positioned within the standard electrical junction box and at least a portion of the mounting ring is adjacent a flat surface to which the standard electrical junction box is mounted. A plurality of spacing tabs on an inner surface of the sink between the heat sink and the mounting ring. An air intake opening formed between an outer surface of the mounting ring and the inner surface of the heat sink, wherein, responsive to activation of the fan, air flows into the LED light system through the air intake opening, through the two outer openings, through the fan housing aperture, and out the air exhaust openings. The mounting ring may be coupled to the heat sink with one or more biased mounting tabs and an outer periphery of the mounting ring is substantially aligned with the outer periphery of the heat sink. The lighting system may further comprise a semiconductor chip comprising an input coupled to an AC power supply and further comprising a plurality of DC power outputs, wherein the one or more LEDs comprises a plurality of banks of LEDs coupled to the plurality of DC power outputs, and wherein the fan is further coupled in parallel with a first of the plurality of banks of LEDs.

According to another aspect, a light emitting diode (LED) lighting system, comprises one or more LEDs, a heat sink coupled to the one or more LEDs, a mounting ring, a fan housing, and a fan. The heat sink comprises a platform, a sink wall, and an air exhaust opening heat sink. The mounting ring is coupled to the heat sink opposite the one or more LEDs, the mounting ring comprising one or more screw holes positioned to mount the LED lighting system to an electrical junction box mounted to a flat surface. The fan housing is coupled to the platform of the heat sink opposite the one or more LEDs and sized to fit within a single gang electrical junction box, the fan housing comprising an end wall, a dividing wall coupled to the end wall and comprising a terminating end aligned with and adjacent to the sink wall, an outer opening positioned between the end wall and the divid-

ing wall, a fan housing aperture within the fan housing, and a cover opposite the heat sink. The fan is coupled to the fan housing and positioned at least partially within the fan housing aperture, wherein, responsive to activation of the fan, airflow enters the fan housing through the outer opening, passes through the fan housing aperture to interface with the heat sink, and the exits through the air exhaust opening of the heat sink.

Various implementations and embodiments may comprise one or more of the following. The sink wall may comprise two sink walls. The air exhaust openings may comprise two air exhaust openings extending through the platform, each air exhaust opening positioned between a different sink wall and the platform. The end wall of the fan housing may comprise two opposing end walls, the fan housing further comprising two opposing sidewalls positioned between the two end walls. The dividing wall of the fan housing may comprise two opposing dividing walls each comprising a terminating end aligned with and adjacent to a different one of the two sink walls, the fan housing aperture being positioned between the two dividing walls. The outer opening may comprise two outer openings positioned between a different end wall of the two end walls and a different dividing wall of the two dividing walls. The dividing walls, the end walls, and the sidewalls of the fan housing may be integral with one another. The heat sink may comprise an outer wall at an outer periphery, a heat sink channel formed between the outer wall and each of the heat sink walls, one or more screw holes, and a plurality of air intake openings extending through the outer wall. The plurality of air intake openings may be positioned within an angled portion of the outer wall and the heat sink may comprise a plurality of arced ribs extending from the platform toward the fan housing. A bulb-like housing coupled to the mounting ring such that the fan housing is housed within the bulb-like housing, the bulb like housing comprising an open end coupled to the heat sink and a closed end coupled to a socket fitting operably coupled to the one or more LEDs and the fan, wherein, responsive to activation of the fan, air flows into the LED light system through the air intake openings, through the two outer openings, through the fan housing aperture, and out the air exhaust openings, each air exhaust opening being separated from the air intake openings by at least the respective sink wall. A mounting ring removably coupled to the heat sink, the mounting box comprising one or more screw holes positioned to align with one or more screw mounts on a standard electrical junction box such that when the mounting ring is coupled to the standard electrical junction box, the fan housing is positioned within the standard electrical junction box and at least a portion of the mounting ring is adjacent a flat wall to which the standard electrical junction box is mounted. A plurality of spacing tabs on an inner surface of the sink between the heat sink and the mounting ring. An air intake opening formed between an outer surface of the mounting ring and the inner surface of the heat sink, wherein, responsive to activation of the fan, air flows into the LED light system through the air intake opening, through the two outer openings, through the fan housing aperture, and out the air exhaust openings. The mounting ring may be coupled to the heat sink with one or more biased mounting tabs and an outer periphery of the mounting ring is substantially aligned with the outer periphery of the heat sink. The lighting system may comprise a semiconductor chip comprising an input coupled to an AC power supply and further comprising a plurality of DC power outputs, wherein the one or more LEDs comprises a plurality of banks of LEDs coupled to the plurality of DC power outputs, and wherein the fan is further coupled in parallel with a first of the plurality of banks of LEDs.

According to another aspect, a light emitting diode (LED) lighting system comprises a heat sink, a fan housing, one or more LEDs, and a fan. The heat sink comprises a plurality of arced ribs extending from an outer periphery of the heat towards a center of the heat sink. The fan housing is coupled to the heat sink adjacent the plurality of arced ribs such that a plurality of air exhaust openings are formed on the outer periphery of the heat sink between the heat sink and a first end of the fan housing, the fan housing comprising a plurality of air intake openings on an outer periphery of the fan housing distal the air exhaust openings. The one or more LEDs are coupled to the heat sink opposite the fan housing. The fan is mounted within the fan housing, wherein, responsive to activation of the fan, air flows into the fan housing through the air intake openings and out the fan housing through the air exhaust openings.

Various implementations and embodiments may comprise one or more of the following. The plurality of air intake openings may be on an angled portion of the outer periphery of the fan housing. The heat sink may comprise a circular heat sink and the fan housing comprises a substantially cylindrical housing. A diameter of the heat sink may be substantially equal to a diameter of the first end of the fan housing. A plurality of coupling posts extending from the head sink and engaged with a plurality of tab receivers on the fan housing. A cover coupled to the second end of the housing. The cover may comprise a threaded coupling. The cover may be configured to mount to a flat surface having a mounting hole therein such that the heat sink is substantially parallel to the flat surface.

According to another aspect, a method of mounting a light emitting diode (LED) lighting system to a flat surface comprises inserting a fan housing of the LED lighting system into an electrical junction box adjacent the flat surface, the fan housing comprising an end wall, a dividing wall, an outer opening positioned between the end wall and the dividing wall, and a fan housing aperture within the fan housing with a fan mounted therein; and coupling a heat sink of the LED lighting system to the electrical junction box, the heat sink being coupled to the fan housing and comprising a platform adjacent the fan housing, a sink wall adjacent the dividing wall, and an air exhaust positioned on a side of the dividing wall opposite the outer opening such that, responsive to activation of the fan, air flows into the housing through outer opening, through the fan housing aperture, and out of the LED lighting system through the air exhaust opening.

Various implementations and embodiments may comprise one or more of the following. Coupling a mounting ring to the electrical junction box. Coupling the heat sink to the electrical junction box may comprise coupling the heat sink to the mounting ring coupled to the electrical junction box. Transmitting AC power to a semiconductor chip of the LED lighting system, transmitting DC power from the semiconductor chip to a first bank of LEDs and not a second bank of LEDs, transmitting DC power from the semiconductor chip to the second bank of LEDs and not the first bank of LEDs, and operating the fan at a speed proportional to a brightness of the first and second banks of LEDs. Operating the fan by transmitting DC power from the semiconductor chip through the first bank of LEDs to the fan. Operating the fan by transmitting DC power from the first bank of LEDs through a filter to the fan.

The foregoing and other aspects, features, and advantages will be apparent to those artisans of ordinary skill in the art from the DESCRIPTION and DRAWINGS, and from the CLAIMS.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will hereinafter be described in conjunction with the appended drawings, where like designations denote like elements, and:

FIG. **1** is a perspective view of an exemplary light emitting diode (LED) circuit;

FIG. **2** is a break apart view of a first embodiment of a LED cooling system;

FIG. **3** is a cross sectional view of a first embodiment of a LED cooling system;

FIG. **4** is a top view of a first embodiment of a heat sink;

FIG. **5**A a top view of a first embodiment of a fan housing;

FIG. **5**B is a bottom perspective view of a first embodiment of a fan housing;

FIG. **6** is a break apart view of a second embodiment of a LED cooling system;

FIG. **7** is a cross sectional view of a second embodiment of a LED cooling system;

FIG. **8** is a top view of a second embodiment of a heat sink;

FIG. **9**A is a top view of a second embodiment of a fan housing;

FIG. **9**B is a bottom perspective view of a second embodiment of a fan housing;

FIG. **10** is a perspective view of a fan;

FIG. **11** is a break apart view of a power adapter and Wi-Fi module and a cover

FIG. **12** is a perspective view of a third embodiment of an LED cooling system coupled to a bulb-like housing;

FIG. **13** is an exploded perspective view of a third embodiment of an LED cooling system;

FIG. **14** is a rear perspective view of a third embodiment of an LED cooling system;

FIG. **15** is a front perspective view of a third embodiment of a heat sink;

FIG. **16** is a rear view of a third embodiment of a head sink;

FIG. **17** is a front perspective view of a third embodiment of a fan housing;

FIG. **18** is a rear view of a third embodiment of a fan housing;

FIG. **19** is a front perspective view of a first embodiment of a mounting ring;

FIG. **20** is a cross-sectional view of a third embodiment of a LED cooling system taken along line A-A of FIG. **14**;

FIG. **21** is a perspective view of a LED and electrical couplings;

FIG. **22** is a front perspective view of a fourth embodiment of an LED cooling system;

FIG. **23** is a rear perspective view of a fourth embodiment of an LED cooling system;

FIG. **24** is a front perspective view of a fourth embodiment of a heat sink;

FIG. **25** is an exploded perspective view of a fourth embodiment of an LED cooling system;

FIG. **26** is a rear view of a fourth embodiment of a heat sink;

FIG. **27** is a perspective view of a fourth embodiment of an LED cooling system within a housing;

FIG. **28** is a cross-sectional view of a fourth embodiment of an LED cooling system taken along line B-B of FIG. **27**;

FIG. **29** is a cross-sectional view of a fourth embodiment of an LED cooling system taken along line B-B of FIG. **27** and coupled to a flat surface;

FIG. **30** is a rear perspective view of a fifth embodiment of an LED cooling system coupled a first cover;

FIG. **31** is a rear perspective view of a fifth embodiment of an LED cooling system coupled to a second cover;

FIG. **32** is a rear perspective view of a fifth embodiment of an LED cooling system coupled to a third cover;

FIG. **33** is a front perspective view of a fifth embodiment of a heat sink;

FIG. **34** is a front perspective view of a fifth embodiment of a fan housing;

FIG. **35** is a rear perspective view of a fifth embodiment of a heat sink;

FIG. **36** is a rear perspective view of a fifth embodiment of a fan housing;

FIG. **37** is a cross-sectional side view of a fifth embodiment of an LED cooling system taken along line C-C of FIG. **30**;

FIG. **38** is an exploded view of a fifth embodiment of an LED cooling system;

FIGS. **39**A and **39**B are schematic diagrams that illustrate LED devices comprising fans;

FIG. **40** is a schematic diagram that illustrates additional detail of an LED device comprising a fan;

FIG. **41** is a perspective view of an embodiment of an LED device comprising a housing;

FIG. **42** in a cut away cross-sectional view of the embodiment of the LED device of FIGS. **41**; and

FIG. **43** is a perspective view of another embodiment of an LED device comprising a housing.

DESCRIPTION

This disclosure, its aspects and implementations, are not limited to the specific components or assembly procedures disclosed herein. Many additional components and assembly procedures known in the art consistent with the intended light emitting diode (LED) cooling system and/or assembly procedures for a LED cooling system will become apparent for use with implementations of LED cooling systems from this disclosure. Accordingly, for example, although particular LEDs, heat sinks, fan housings, covers, boxes, adapters, and the like are disclosed, such LEDs, heat sinks, fan housings, covers, boxes, and adapters and implementing components may comprise any shape, size, style, type, model, version, measurement, concentration, material, quantity, and/or the like as is known in the art for such LED cooling assemblies and implementing components, consistent with the intended operation of an LED cooling assembly.

LEDs are source of light gaining popularity throughout the country and the world largely due to the LED typically consuming less energy and lasting longer. While some LEDs may also manage heat better than previous sources of light, it is well known that previous LEDs still become hot, thus lessening efficiency or resulting in a safety hazard. Embodiments of the cooling systems and assemblies disclosed herein provide a fan **7** to assist in cooling the LED, as well as configurations for efficient cool of the LED and elements associated with the LED assembly.

One of more embodiments of a LED cooling system **100**, **200** comprise an LED **5**. FIG. **1** illustrates exemplary an embodiment of an LED **5** utilized in a LED cooling system **100**, **200**, the LED **5** requiring a 120 volt or appropriate input. It is contemplated, however, that in other embodiments, any LED known in the art may be substituted or modified for use in embodiments of an LED cooling system **100** disclosed herein.

FIG. **2** illustrates an exploded perspective view of one exemplary embodiment of a LED cooling system comprising an cover plate **10** that includes LED **5**, a heat sink **20**, a fan housing **30**, a cover **40**, and an electrical junction box **50** (sometimes called a J-Box in the relevant industry). In some applications of the various embodiments shown herein, the electrical junction box **50** may or may not be used, and, alternatively, the housing **30** and/or cover **40** may not be used. Electrical junction boxes **50**, come in standard depths including, but not limited to, 1", 2" and 3". In particular implementations, the LED **5**, heat sink **20**, fan housing **30** and cover **40** may all fit within even a 1" electrical junction box **50**. Although not shown in FIG. **2**, a fan **7** may also be nesting at least partially within the fan housing **30**. As shown in greater detail in FIG. **3**, a particular embodiment of the heat sink **20** is substantially circular in shape. Other embodiments of the heat sink **20**, however, may comprise other shapes to correspond to the shape of the fan housing **30**, as shall be described.

One or more embodiments of the heat sink **20** comprise a circular platform **26** at least partially surrounded by an annular opening **23**. In embodiments wherein the platform **26** comprises a non-circular shape, the annular opening **23** comprises a shape corresponding to the shape of the platform **26**. Embodiments of the platform **26** comprise one or more dividers **24** or spacers. The dividers **24** typically comprise posts or other protrusions extending from one side of the platform **26**. Ideally, the dividers **24** may be positioned to assist in distributing airflow from the fan **7** in a substantially uniform manner, thus improving heat dissipation. FIG. **4** illustrates one exemplary arrangement of the dividers **24** on the platform **26**. It should be recognized that other embodiments of the heat sink **20** may comprise fewer or greater dividers **24** positioned in other arrangements without departing from the scope of this disclosure. One or more embodiments of the heat sink **20** further comprise a raised center lip **25** or member which may provide support or positioning for the fan **7**. In other embodiments, a thermal switch may replace the raised center lip **25**.

One or more embodiments of the heat sink **20** also comprise a sink wall **22** positioned about the platform **26**. The annular opening **23** typically separates at least a portion or all of the platform **26** from the sink wall **22**. In embodiments wherein the annular opening **23** separates the platform from the sink wall **22**, one or more connectors may bridge across the annular opening to couple the platform **26** to the sink wall **22**. One or more embodiments also may comprise at least one fastener mount **21**, typically positioned as two opposing fastener mounts extending from opposing sides of the sink wall **22**. In other embodiments, the fastener mounts may be positioned on or extend from the platform **26**.

FIGS. **5**A and **5**B illustrate an embodiment of a fan housing **30**. At least a portion of the fan housing **30** is typically shaped to complement at least a portion of the heat sink **20**. For example, in the embodiment of the fan housing **30** illustrated in FIGS. **5**A and **5**B, the fan housing **30** comprises a substantially conical sloped body **31** with a based sized equal or substantially equal to the platform **26**. In some embodiments, the base of the sloped body **31** may be sized equal or substantially equal to the sink wall **22** to provide different air intakes. Although the sloped body **31** is shown as a conical sloped body **31** in FIGS. **5**A and **5**B, other shaped sloped bodies are also contemplated, such as but not limited to a pyramid sloped body.

One or more embodiments of a fan housing **30** also comprise a fan housing wall **32**. The fan housing wall **32** typically comprises at least one convex portion. In the embodiment shown in FIG. **5**B, the fan housing wall **32** comprises an open convex portion **33** separated at least partially from the sloped body **31** by an outer opening **34**. Opposite the open convex portion **33** is an enclosed convex portion **36**. The enclosed convex portion **36** may comprise a height substantially equally to the height of the open convex portion **33** or alternatively, as shown in the exemplary embodiment of FIG. **5**B, a height substantially equal to a base rim **37** extending from a portion of a base end of the sloped body **31**. In the latter, the fan housing wall **32** may comprise a convex portion **33** and a U-shaped portion. In other embodiments, the convex portion may comprise a flat portion that still provides and outer opening **34** between the wall **33** and the sloped body.

The fan housing **30** further comprises a fan housing aperture **35** extending through the fan housing **30**. The fan housing aperture **35** is in fluid communication with the outer opening **34**, even when the cover **40** is coupled to a top end of the fan housing **30**. As such, the fan housing wall **32** typically comprises a height greater than the height of the sloped body **31** within the fan housing **30**. In one or more embodiments, the fan housing aperture **35** is at least partially formed by the boundaries of the sloped body **31** and the base rim **37**. A wire hole **38** is also positioned to extending through a portion of the sloped body **31** in one or more embodiments.

FIG. **3** illustrates a cross-sectioned view of an embodiment of a portion of an LED cooling system **100**. Although not shown in FIG. **3**, the LED **5** and/or cover plate **10** are typically positioned or coupled beneath the platform **26**. As shown, portions of the fan housing **30** and the heat sink **20** abut one another when coupled together. For example, the open convex portion **33** of the fan housing wall **32** typically abuts a portion of the sink wall **22**, and a portion of the enclosed convex portion **36** abuts another portion of the sink wall **22**. When coupled in such an alignment, the outer opening **34** aligns with and is in fluid communication with a first portion of the annular opening **23**, and the chamber or opening within the enclosed convex portion **36** aligns with and is in fluid communication with a second portion of the annular opening **23**. A cover **40** is typically coupled to the fan housing wall **32** to cover the top of the fan housing wall **32**.

The fan **7** is typically coupled to either the sloped body **31** or the raised center lip **25**. When activated, the fan **7** draws air in through the air intake opening **2** formed by the first portion of the annular opening **23**. Because the fan housing aperture **35**, the outer opening **34**, and the first portion of the annular opening are all in fluid communication with one another, activation of the fan **7** and the subsequent drawing of external air into the air intake **2** results in at least a portion of the external air being drawn into the fan housing **30** to the fan **7**. The air is then dispersed by the fan **7** toward the platform **26**. Because the second portion of the annular opening **23** is in fluid communication with the chamber of the enclosed convex portion **36**, which is in fluid communication with the fan housing aperture **35**, air within the sloped body **31** exhausts through the air exhaust opening **4** when the fan **7** is activate. By drawing external air into the sloped body **31** and blowing the air onto the platform **26** of the heat sink **20** before the air is ultimately exhausted, the overall temperature of the system **100**, and particularly the heat sink **20** and the LED **5** is decreased.

A electrical junction box, or other in-wall mountable electrical housing box, (J-box) **50** may also be included in one or more embodiments of an LED cooling system **100**, **200**. J-Boxes, which are well known in the art and come in standard sizes with limited internal boundaries, is typically configured as a rectangular or cylindrical shape and is configured to house electrical components mounted in a wall or house wiring for electrical components. For particular embodiments of the present disclosure, portions of the heat sink **20**, **70**, the fan housing **30**, **80**, the cover **40**, **90**, and the adapter **60** are sized to fit within a standard J-Box. As used herein, a standard single-gang J-Box comprises a J-box having a volume of between approximately 14 cubic inches and approximately 21 cubic inches. According to various embodiments, the LED lighting systems contemplated in this disclosure are sized and configured for mounting within a single gang J-box having a volume of approximately 14 cubic inches. Other LED lighting systems may also be sized and configured to fit within other J-boxes of varying dimension and volumes. In one or more embodiments, the J-box **50** couples to the face plate **10**. When coupled to the face plate **10**, the J-box is positioned to abut the face plate **10** with a base of the J-box **50** or leave a gap or space between the base of the J-box **50** and the LED plate. Various embodiments of the LED cooling system **100**, **200** are configured to fit within a standard electrical junction box typically offered in the housing industry. In some embodiments, the base of the J-box **50** abuts or is in direct contact with the plate **10**, and air is drawn into and exhausted from the LED cooling system **100**, **200** through an annular opening on the face plate **10**. The J-box **50** may be utilized to hold the heat sink **20**, **70**, the fan housing **30**, **80**, and the cover **40**, **90** together. Alternatively or additionally, various couplings known to a person having skill in the art may utilize to couple the heat sink **20**, **70**, the fan housing **30**, **80**, and the cover **40**, **90** together, such as but not limit to screws, pins, adhesives, and the like.

FIG. **6** illustrates another embodiment of an LED cooling system **200**. Similar to LED cooling system **100**, the LED cooling system **200** shown in an exploded view in FIG. **6** comprises an face plate **10**, LED **5**, and J-box **50** as previously described. The LED cooling system **200** also comprises a heat sink **70**, a fan housing **80**, and cover **90**, although the configuration of these varies from the configuration of LED cooling system **100** as described below.

As shown in FIG. **6**-**8**, the LED cooling system **200** comprises a heat sink **70**. Although the heat sink **70** shown in FIGS. **6** and **8** is substantially circular in shape, embodiments of heat sinks comprises non-circular shapes (such as a rectangle, triangle, and the like) are also contemplated. One or more embodiments of the heat sink **70** comprise a circular platform **76** and a circular sink wall **72** separated by an annular opening **73**. An array of ribs **74** may extend from a raised center member **75** on the platform **76** to the sink wall **72**, thus bridge the annular opening **73** and coupling the platform **76** to the sink wall **72**. In a particular embodiment, such as that shown in FIGS. **6** and **8**, the ribs **74** comprise arced ribs **74**. Ends of the ribs **74** opposite the raised center member **74** may be configured such that the ribs **74** do not contact the sloped body **81** when the fan housing **80** is coupled to the heat sink **70**.

One or more embodiments of the heat sink **70** further comprise at least one sink lip **77** extending from the sink wall **72**. In the embodiment shown in FIG. **8**, the heat sink **70** comprises two opposing sink lips **77** each extending from the sink wall **72**. The sink lips **77** typically extending from a base end of the sink wall **72**. Embodiments of the heat sink **70** may further comprise at least one fastener mount **71** also extending from the sink wall **72**. In the embodiment shown in FIGS. **6** and **8**, the heat sink **70** comprises two opposing fastener mounts **71** positioned proximate the opposing sink lips **77**. When positioned proximate one another, a sink lip **77** and a fastener mount **71** are at different heights on the sink wall **72** in some embodiments. For example, while the sink lip **77** may extend from a base end of the sink wall **72**, the fastener mount **71** may extend from a top end of the sink wall **72** opposite the base end. In one or more embodiments, the fastener mounts **71** are positioned opposite one another and between the opposing sink lips **77** rather than proximate the opposing sink lips **77**. In another embodiment, one or more fastener mounts **71** are positioned on or proximate the platform **76** such that the one or more fastener mounts **71** align with standard J-box housing **50**. The heat sink **70** may further comprise one or more mounting holes for mounting the LED **5** to the heat sink **70**, or, alternatively, coupling the heat sink **70** to the fan housing **80**. The mounting holes are typically positioned on the platform **76**.

FIGS. **9**A and **9**B illustrate top and perspective views, respectively, of an embodiment of a fan housing **80**. The fan housing **80** typically comprises a dividing wall, such as a sloped body **81** partially within the fan housing walls **82**. The fan housing walls **82**, in one or more embodiments, comprises two opposing end walls and two opposing sidewalls. In the specific, non-limiting embodiment of FIGS. **9**A and **9**B, the two opposing end walls comprise two opposing convex portions **83** and the two opposing sidewalls comprise two opposing concave portions positioned between the two opposing convex portions **83**. Various embodiments may also include a planar connector wall between each convex portion **83** and concave portion **86**.

The sloped body **81** is typically shaped such that the base end of the sloped body **81** complements at least a portion of the sink wall **72**. In FIG. **9**B, the sloped body **81** comprises a substantially conical sloped body **81**. Portions of the based end of the sloped body **81** may be planar, as shown in FIG. **9**A. Extending from a top end of the sloped body **81** is a rim **87** in various embodiments. The rim **87** and the sloped body **81** together (or individually) form the boundary of a fan housing aperture extending through the sloped body **81**. The fan housing wall **82** typically comprises a height dimension greater than a height dimension of the sloped body **81** (and the rim **87**, if included). One or more embodiments of the fan housing **80** further comprise a fan mount **88** coupled to the sloped body **81** or the rim **87** within the fan housing aperture **85**. As shown in FIG. **9**B, wire slot **89** may also extend through the sloped body **81**.

In one or more embodiments, at least one outer opening **84** is positioned between a convex portion **83** of the fan housing wall **82** and a portion of the sloped body **81**. In the embodiment shown in FIGS. **9**A and **9**B, the fan housing **80** comprises two opposing outer openings **84**, each outer opening **84** positioned between a different convex portion **83** of the fan housing wall **82** and a different portion of the sloped body **81**. Because the height dimension of the sloped body **81** is less than the height dimension of the fan housing wall **82**, each outer opening **84** is in fluid communication with the fan housing aperture **85**.

FIGS. **17** and **18** depict various views of another non-limiting embodiment of a fan housing **140**. The fan housing may be utilized with any of the LED lighting and cooling systems disclosed in this document. According to some aspects, a fan housing comprises one or more end walls **142**. Dependent upon the configuration of the heat sink, in some embodiments the one or more end walls **142** comprise a circular wall. In other embodiments, such as the non-limiting embodiment depicted in FIGS. **14**, **16**, **18**, **23**, and **25** the fan housing **140** comprises two end walls **142** and two sidewalls **144**. The two end walls **142** are typically opposite one another and separated by the two sidewalls **144**, which sidewalls **144** are also opposite one another. In one or more embodiments, the sidewalls **144** of a fan housing **140** are substantially planar.

Similar to some embodiments of the fan housing **80**, some embodiments of the fan housing **140** comprise two opposing curved or convex end wall **142**. In other embodiments, however, the outer wall may be substantially planar. As is shown in FIGS. **14** and **20**, and described in greater detail below, in some embodiments of a fan housing **140**, the end walls **142** are configured such that when the fan housing is coupled to a heat sink **112**, **192**, the end walls **142** are positioned between the sink wall **122**, **202** and the outer periphery **118**, **198** of the heat sink **112**, **192**. Similarly, when the fan housing **140** is coupled to a heat sink **70**, the each end wall **142** is positioned between the sink wall **72** and the outer most edge of a different fastener mount **71**.

In one or more embodiments, a fan housing **140** comprises one or more dividing walls **146** positioned within the chamber formed by the end walls **142** and the sidewalls **144**. The one or more dividing walls **146** are configured to divide or otherwise separate air flowing into the fan housing **140** and air flowing out of the fan housing **140**. According to some aspects, each dividing wall **146** comprises a sloped body **150** and a rim **152**. In the non-limiting embodiment depicted in FIGS. **17**, **18**, and **20**, the fan housing **140** comprises two dividing walls **146** each comprising a sloped body **150** and a rim **152**. The sloped bodies **150** depicted in FIGS. **17** and **18** each intersect and are coupled to the two opposing sidewalls **144**. The sloped bodies **150** are configured such that if they continued through the sidewalls **144**, the two sloped bodies **150** would form a cone.

Each dividing wall **146** further comprises a terminating end **148**. The terminating end **148** is typically on an end of the sloped body **150** distal the rim **152**. The terminating end **148** is configured to align with and be adjacent to a sink wall **72**, **122**, **202** of a heat sink **70**, **112**, **192** when the fan housing is coupled thereto. Accordingly, the terminating end **148** of the dividing wall **146** is typically arced substantially equal to the arc of the respective sink wall **72**, **122**, **202**.

A rim **152** of a dividing wall **146** is typically positioned opposite a terminating end **148** of the dividing wall **146**. In particular embodiments, the rims **152** of the two opposing dividing walls **146** are positioned to form a singular and continuously circular rim. The rims **152** are sized and positioned such that a fan **164** may be positioned therein. A fan housing aperture **162** is formed at the rims **152**, the fan housing aperture **162** allowing fluid communication between the outer opening **160** and the fan **164** (when mounted therein), and between the fan **164** and the platform **76**, **120**, **200** and openings **73**, **124**, **204** of the heat sink **70**, **112**, **192**. In one or more embodiments, the fan housing **140** comprises a fan mount **154** configured to mount or couple a fan **164** within the fan housing **140**. In particular embodiments, the fan mount **154** is positioned within the fan housing aperture **162** and extends from one or more sloped bodies **150** of the dividing walls **146**.

As noted above, each fan housing **140** typically further comprises an outer opening **160**. The outer opening **160** is configured to allow air to flow into or out of the fan housing **140** upon activation of the fan **162**. In one or more embodiments, each outer opening **160** is positioned between a dividing wall **146** and an end wall **142**. More particularly, an outer opening may be positioned between a terminating end **148** of the sloped body **150** and the nearest end wall **142**.

One or more embodiments of a fan housing **140** further comprise at least one coupling **158** configured to removably couple a cover **166** to the end wall **142** and or sidewalls **144** of the fan housing **140**. According to some aspects, the couplings **158** are positioned proximate the rim **152** and/or the sidewall **144**. In other embodiments, the couplings may be positioned on or near the end walls **142**. The couplings may comprise any coupling that allows for removable for fixable coupling of a cover **166** to the sidewalls **144** and/or the end wall **142**, such as but not limited to snap couplings, biased couplings, pins, screws, and the like.

According to some aspects, the fan housing may be integrally formed. More particularly, in one or more embodiments, the end walls **142**, the sidewalls **144**, the dividing walls **146**, and the fan mount **154** are integrally formed. In some embodiments, the cover **166** may also be integrally formed, while in other embodiments, the cover **166** is not integrally formed with other aspects of the fan housing **140**.

Various embodiments further comprise a cover **166**. As previously noted, the cover **166** is typically configured to removably of fixedly couple to couplings **158** positioned elsewhere on the fan housing **140** such that the cover **166** is distal the heat sink **70**, **112**, **192**. The cover **166** is configured to substantially prevent or otherwise inhibit air from escaping from a top end of the fan housing **140**. Instead, the cover **166** is configured to allow air to enter the fan housing **140** through the outer opening **160** and exit the fan housing **140** through the fan housing aperture **160**. The cover **166** may further comprise an adapter board and/or a circuit board **168** configured for operation of the lighting device as described herein and as understood by those of ordinary skill in the art of LED lighting from this disclosure.

One or more embodiments of a fan housing **140** are configured to fit within a J-Box **50**. The same or other embodiments are of a fan housing **140** are also configured to fit within a bulb-like housing **180**, as depicted in FIG. **12**. Thus, configuration of a fan housing **140** is advantageous to conventional fan housings, which typically cannot be mounted within a J-Box **50** or interchangeable between mounting within a bulb-like housing **180** and a J-Box **50**.

One or more embodiments of a fan housing **140** further comprising a plurality of a coupling tabs **157** extending from the side of the housing adjacent or abutting a heat sink. The coupling tabs **157** are configured to extend into receivers on the heat sink to couple the fan housing **140** to the heat sink. In some embodiments, the coupling tabs **157** comprise biased coupling tabs. In these or alternative embodiments, the coupling tabs comprise a head that allows the coupling tab **157** to clip or snap fit the fan housing **140** to the heat sink.

FIG. **7** illustrates a partial cross-sectioned view of a LED cooling system **200**. Although not shown in FIG. **7**, a LED **5** and/or face plate **10** are sometimes coupled to the heat sink **70** below the heat sink **70**. As shown in FIG. **7**, each opposing concave portion **83** of the fan housing wall **82** abuts or contacts a fastener mount **71**. Because the fastener mount **71** and the sink lip **77** extend from the sink wall **72** at different heights, an air intake opening **102** is formed between the sink lip **72** and the fan housing walls **82**. The air intake opening **102** is in fluid communication with the outer opening **84** of the fan housing **80**, which outer opening is in fluid communication with the fan housing aperture **85**.

FIG. **7** further illustrates an air exhaust opening **104** formed by the annular opening **73** of the heat sink **70**. The base end of the sloped body **81** abuts the sink wall **72** in one or more embodiments. Thus the air exhaust opening **104** is in fluid communication with the annular opening **73** and the fan housing aperture **85**.

Upon activation of the fan **7** within the rim **87** and sloped body **81**, external air is drawn from outside the system through the two opposing air intake openings **102**, through the outer openings **84** of the fan housing **80** to the fan **7** within the sloped body **81**. Rotation of the fan **7** subsequently directs the air towards the platform **76** of the heat sink **70** and ultimately through the two opposing air exhaust openings **104**. Inclusion of the two air intake openings **102** and the two air exhaust openings **104** allows for introduction of more external air through the air intake openings **102** followed by exhaustion of hot air from the system through the two air exhaust openings **104** when the fan is activated. Transfer of the external air through the system and blowing of the fan **7** on the platform **76** results in cooling of the system **200** generally and the platform **76** specifically.

FIG. **11** illustrates an embodiment of a power adapter **60** and a cover **90**. Although not shown with the figures associated with LED cooling system **100**, the power adapter **60** shown in FIG. **11** may be utilized in the either LED cooling system **100** or **200**. The power adapter typically comprises an AC input **62** and a DC output **61**. According to various aspects, the power adapter **60** further comprises a removable wi-fi module **63**. The wi-fi module may comprise any wi-fi module known in the art configured for use in the LED cooling system. The wi-fi module **63** is configured to allow a user to control the light functions through a communication network. As shown in FIG. **11**, one or more embodiments of a cover **90** comprise an adapter channel positioned between two channel walls **94**. The channel walls **94** typically extend from a cover base **93** shaped to align with the fan housing walls **82**. Some embodiments of the channel walls **94** comprise arced interior portions that allow for removable coupling of the adapter **60** within the adapter channel **91**. A fan wire slot **92** may also extend through the cover base **93** and align with the wire slot **89** of the fan housing **80**.

FIG. **10** illustrates an embodiment of a fan **7** used in various embodiments of LED cooling systems disclosed herein. Any fan sized to fit within the fan housing apertures **35**, **85** may be utilized in various embodiments. In particular embodiments, the fan **7** comprises a fan housing shaped to complement the sloped body **31**, **81** and the rim **87** of the fan housing **30**, **80**. One or more embodiments of the fan **7** comprise three blades and four struts. The adapter **60** and/or batteries may provide power to activate the fan **7**. In one or more embodiments, the fan **7** is included within the fan housing **30**, **80** during assembly, while in other embodiments, the fan **7** may be removably coupled within the fan housing **30**, **80** after assembly. The fan **7** may be coupled to the fan housing **30**, **80** with any couplings known in the art, such as but not limited to screws, pins, adhesives, magnets, and the like.

FIG. **18** depicts another embodiment of a fan **164** contemplated for use with various embodiments of this disclosure. The fan **164** is typically sized to fit within the fan housing aperture **162** and, more particularly, within the circular rim **152** formed between the dividing walls **146**. In particular embodiments, the fan **164** does not require or include the fan housing shown in accordance with the fan **7** of FIG. **10**.

FIGS. **12-20** depict another non-limiting embodiment of a LED lighting and cooling system **110**. FIG. **14** depicts a rear perspective view of a LED lighting and cooling system **110** having a housing **140** coupled to a heat sink **112**. Although the fan housing **140** is depicted in these figures, it is contemplated that the fan housing **80** or other fan housing embodiments described herein may be substituted without departing from the scope of this disclosure. FIG. **13** depicts an exploded view of a non-limiting embodiment of a LED lighting system **110**. According to some aspects, a LED lighting system **11** comprises a LED **5**, an LED cover **111**, a heat sink **112**, and a fan housing **140**. More particular embodiments may further comprise a bulb-like housing **180** (shown in FIGS. **12** and **13**), although this bulb-like housing **180** is not required in all LED lighting systems **110**.

LED lighting system **110** typically comprises a heat sink **112**. FIG. **15** depicts a front view and FIG. **16** depicts a rear view of a non-limiting embodiment of a heat sink **112**. The heat sink **112** may comprise any metal known in the art. In one or more embodiments, the entire heat sink **112** is metal. In other embodiments, portions of the heat sink may not be metal, as shall be described in greater detail below. According to some aspects, a heat sink **112** comprises an outer surface **114**, to which the LED **5** and LED cover **111** are coupled, and an inner surface **116**, to which the fan housing **140** is coupled.

Embodiments of a heat sink **112** further comprise an outer periphery **118**. Although the outer periphery **118** shown in FIGS. **15** and **16** is substantially circular, it is contemplated that the outer periphery may comprise any other shape. According to some aspects, a heat sink **112** further comprises an outer wall **128** positioned on the outer periphery **118** of the heat sink **112**. The outer wall **128** may extend out from the surface **116**, out from the outer surface **114**, or both. In one or more embodiments, the outer wall **128** comprises an angled portion **134**.

In one or more embodiments, a heat sink **112** further comprises one or more air intake openings **132**. Typically, a plurality of air intake openings **132** extend through the heat sink **112**. According to some aspects, the air intake openings **132** extend through the outer wall **128** of a heat sink **112**. More particularly, the air intake openings **132** may extend through the angled portion **134** of the outer wall **128** of the heat sink **112**. Positioning of the air intake openings **132** on the angle portion **134** of the outer wall **128** creates a larger surface area of each air intake opening **132** due to the angle configuration of the angled portion **134**. This greater surface area allows for a greater volume of air to flow into the LED lighting system **110**, which in turn creates a more efficient cooling system in the LED lighting system **110**.

One or more embodiments of a heat sink **112** further comprise a platform **120** extending from the inner surface **116** of the heat sink **112**. The platform **120** may be shaped substantially similar to the shape of the heat sink **112**, such as but not limited to a circular shape. According to some aspects, the platform **120** is substantially and continuously solid. In other embodiments, the platform may comprise various openings extending therethrough or chambers positioned therein. In the particular non-limiting embodiment depicted in FIG. **16**, the heat sink **112** comprises two air exhaust openings **124** extending through the platform **120** or otherwise adjacent to the platform **120**. The heat sink **112** typically further comprises a sink wall **122** bordering each air exhaust opening **124** such that the air exhaust opening **124** is positioned between a sink wall **122** and a portion of the platform **120**. The sink wall **122** may be connected to or continuous with the platform **120** or, alternatively a separate protrusion from the platform **120**.

In one or more embodiments of a heat sink **112**, each sink wall **122** is adjacent to or abutting with a different one of the terminating ends **148** of the dividing wall **146** of the fan housing **140** when the heat sink **112** is coupled to the fan housing **140**. In such a configuration, air exhausts from the fan housing **140** and the LED lighting system **110** through the air exhaust openings **124** upon activation of the fan **164**. Positioning of the sink wall **122** of this non-limiting embodiment is also advantageous over conventional LED lighting systems because the metal sink wall **122** separates air being exhausted from the system from air being brought into the system. Because the sink wall **122** is metal, the sink wall will absorb some of the heat of the air being exhausted from the system, meaning that it is less likely that the sink wall **122** itself will heat air entering the system.

Formed between the outer wall **128** and the platform **120** and/or the sink wall **122** is typically a heat sink channel **130**. According to some aspects, when a fan housing **140** is coupled to a heat sink **112**, each end wall **142** of the fan housing is positioned over the heat sink channel **130** and thus between a sink wall **122** and a portion of the outer periphery **118** of the heat sink **112**. In such embodiments, an outer opening **160** of the fan housing **140** is also positioned over a portion of the heat sink channel **130**.

One or more embodiments of a heat sink **112** further comprise a plurality of arced ribs **136** protruding from the platform **120**. The arced ribs **136** are positioned to enhance air flow as the fan **164** directs air onto the platform **120**, thus improving the efficiency of cooling of the heat sink. The heat sink **112** may further comprise one or more screw holes **126** positioned on the heat sink **112** to allow coupling of the heat sink **112** to a J-Box **50**. In particular embodiments, the heat sink **112** comprises two screw holes **126** spaced at distance from one another to allow a single gang or a double gang J-Box **50** to fit between the two screw holes **126**. Embodiments of a heat sink **112** may further comprise one or more receivers that are configured to couple the fan housing **140** to the heat sink **112**.

FIG. **20** depicts a cross-sectional view of an LED lighting system **110**. In operation, the LED lighting system **110** improves the cooling efficiency of the system in comparison to conventional LED lighting systems. When a fan **164** in the LED lighting system **110** is activated, airflow **133** typically enters the system through the plurality of air exhaust openings **132** on the heat sink **112**, passes through the heat sink channel **130** and into the outer openings **160** of the fan housing **140**. Once within the fan housing **140**, air passes through the fan housing apertures **162** and the airflow **125** is exhausted from the system through the air exhaust openings **124** on the heat sink **112**.

Various embodiments of an LED lighting system **110** further comprise a mounting ring **170** configured to allow the heat sink **112** and housing **140** to couple to a bulb-like housing **180** (shown in FIG. **12**) or a flat surface such as a wall having a J-Box **50** mounted therein. FIG. **19** depicts a non-limiting embodiment of a mounting ring **170**. According to one aspect, the mounting ring **170** comprises a fan housing opening **172** extending through the mounting ring **170** and sized to allow the fan housing **140** to at least partially pass therethrough. The mounting ring **170** typically further comprises a plurality of screw holes **174**. In some embodiments, the mounting ring **170** comprises two screw holes **174** positioned to align with the screw holes on a J-Box **50**. For example, in a non-limiting embodiment, the screw holes **174** are positioned at an approximate distance of between approximately 3.25 inches and approximately 3.5 inches from one another. The mounting ring **170** may further comprise additional screw holes positioned such that either a single gang or double gang J-Box **50** may fit between the additional screw holes. One or more embodiments of a mounting ring **170** further comprise one or more tab openings **176**. The tab openings **176** are positioned to receive the coupling tabs of a bulb-like housing **180** to removably couple the mounting ring **170** to the bulb-like housing **180**.

FIG. **12** depicts a non-limiting embodiment of an LED lighting system **110** coupled to a bulb-like housing **180**, while FIG. **13** depicts an exploded view of an LED lighting system adapted to couple to a bulb-like housing. According to some aspects, the bulb-like housing **180** comprises an open first end **184**, a second end **186** distal the open first end **184**, and a socket fitting **188** coupled to the second end **186**. The socket fitting **188** is typically configured to removably couple to a light socket previously known in the art. The LED lighting system **110** may further comprise one or more electrical wires that operably couple the socket fitting **188** to the circuit board **168** and the fan **164**.

One or more embodiments of a bulb-like housing **180** further comprise at least one coupling tab **182**. The at least one coupling tab **182** is positioned and configured to partially pass through a tab opening **176** on the mounting ring **170**. The coupling tab **182** may comprise a lip that removably couples the mounting ring **170** proximate the bulb-like housing **180**. Before or after the mounting ring **170** is coupled to the bulb-like housing **180**, the heat sink **112** may be coupled to the mounting ring **170** by aligning the screw holes **126** with the additional screw holes on the mounting ring and inserting a screw, rod, or other coupling device. When the mounting ring **170**, the heat sink **112**, and the fan housing **140** are coupled to the bulb-like housing **180**, the fan housing **140** is positioned at least partially within the bulb-like housing **180**. However, the LED lighting system **110** typically does not pass air through the bulb-like housing **180**. Instead, airflow generating by the fan **164** is typically contained within the fan housing **140** and heat sink **112** without a significant or appreciable amount flowing into the bulb-like housing **180**.

FIG. **21** depicts a non-limiting embodiment of a LED **5** and associated power couplings. Whereas conventional LED lighting system requires electrical connections be made by wire, contemplated herein is electrical connections or couplings made with a thin printed circuit board (PCB) **165**, sometimes referred to as flex boards. Thus, in contrast to conventional LED lighting systems, no wire connections or connectors of some disclosed embodiments are located on the LED emitter board. Because wire connection and/or connectors on conventional LED emitter boards require sufficient spacing to meet UL and certification requirements, the LED **5** and the LED lighting system **110** may be significantly smaller than those previously known in the art.

Another advantage of utilizing PCB flex boards **165** is the ease in which the system may be assembled. Conventional systems require time and labor intensive soldering of wire or special terminations. These time and labor intensive aspects are not require according some aspects of this disclosure.

In one or more embodiments, two PCB flex boards **165** are operably coupled to the LED **5** emitter board. According to one aspect, a first PCP flex board **165** is operably coupled to a power source with a first coupling **169**. A second PCP flex board **165** is operably coupled to the fan **164** with a second coupling **167**. The first coupling **169** and second coupling **167** may comprise any type of coupling, such as but not limited to clips for removable couplings.

FIGS. **22**-**29** depict various views of another non-limiting embodiment of a LED lighting system **190**. Various embodiments of a LED lighting system **190** comprise any of the fan housings described herein, including but not limited to a fan housing **140**. FIGS. **22** and **23** depict front and rear perspective views, respectively, of a LED lighting system **190**. As depicted in the exploded view of FIG. **25**, one or more embodiments of a LED lighting system **190** further comprise a heat sink **192**, one or more LEDs **5** coupled to an outer surface of the heat sink **192**, a mounting ring **220** coupled to an inner surface **196** of the heat sink **192**, and an LED cover **191** coupled to the outer surface **194** of the heat sink **192** and positioned to cover the LED **5**. According to some aspects, the heat sink **192** comprises an outer periphery **198**. The outer periphery **192** may comprise any suitable shape, include but not limited to a circular outer periphery **198**.

One or more embodiments of a heat sink **192** further comprise a platform **200** extending from the inner surface **196** of the heat sink **192**. The platform **200** may be shaped substantially similar to the shape of the heat sink **192**, such as but not limited to a circular shape. According to some aspects, the platform **200** is substantially and continuously solid. In other embodiments, the platform may comprise various openings extending therethrough, chambers positioned therein, or lips protruding therefrom. In the particular non-limiting embodiment depicted in FIG. **26**, the heat sink **192** comprises two air exhaust openings **204** extending through the platform **200** or otherwise adjacent to the platform **200**. The heat sink **192** typically further comprises a sink wall **202** bordering each air exhaust opening **204** such that the air exhaust opening **204** is positioned between a sink wall **202** and a portion of the platform **200**. The sink wall **202** may be connected to or continuous with the platform **200** or, alternatively a separate protrusion from the platform **200**.

FIGS. **28** and **29** depicts cross-sectional views of a LED lighting system **190**. In one or more embodiments of a heat sink **192**, each sink wall **202** is adjacent to or abutting with a different one of the terminating ends **148** of the dividing wall **146** of the fan housing **140** when the heat sink **192** is coupled to the fan housing **140**. In such a configuration, air exhausts from the fan housing **140** and the LED lighting system **190** through the air exhaust openings **204** upon activation of the fan **164**. Furthermore, when the fan housing **140** is coupled to the heat sink **192**, the end walls **142** of the fan housing **140** are positioned between the sink wall **202** and the outer periphery **198** of the heat sink **192**. This allows airflow **213** to be drawn into the fan housing **140** through the outer opening **160** of the fan housing **140**. Positioning of the sink wall **202** of this non-limiting embodiment is also advantageous over conventional LED lighting systems because the metal sink wall **202** separates air being exhausted from the system from air being brought into the system. Because the sink wall **202** is metal, the sink wall will absorb some of the heat of the air being exhausted from the system, meaning that it is less likely that the sink wall **202** itself will heat air entering the system.

One or more embodiments of a heat sink **192** further comprise a plurality of spacing tabs **208**. The rear view of FIG. **26** and the cross-sectional views of FIGS. **28** and **29** depict non-limiting embodiments of spacing tabs **208**. The plurality of spacing tabs **208** are typically protrude from the inner surface **196** of the heat sink **192** and may be arranged in an array similar to the shape of the heat sink **192**. The spacing tabs **208** are typically size to interface with a protruding ring **226** on the mounting ring **220**. Interfacing of the plurality of spacing tabs **208** and the protruding ring assists in removably coupling in the mounting ring **220** to the heat sink **192** and positioning the mounting ring **220** adjacent the heat sink in a most effective position. In some embodiments, when the mounting ring **220** is coupled to the heat sink **172**, the spacing tabs **208** directly contact only the protruding ring **226** of the mounting ring **220** and leave a space between the remaining outer surface of the mounting ring and the spacing tabs **208**. In other embodiments, the spacing tabs **208** directly contact both the protruding ring **226** and the planar portion of the outer surface of the mounting ring **220** adjacent the protruding ring **226**.

One or more embodiments of a heat sink **192** further comprise mounting tabs **206**. According to some aspects, the mounting tabs **206** comprise biased mounting tabs. The mounting tabs **206** are typically configured and positioned to engage with a portion of the mounting ring **220** to couple the mounting ring **220** to the heat sink **192**. In the particular embodiment depicted in FIGS. **23** and **26**, the mounting tabs **206** are positioned and configured to partially engage with an inner periphery **228** of the mounting ring **220**, the inner periphery surrounding the fan housing opening **222** of the mounting ring **220**. The mounting tabs **206** may comprise any mounting tab known in the art configured to engage with the mounting ring **220** to removably couple the mounting ring **220** to the heat sink **192**.

According to some aspects, the heat sink **192** comprises a sloped portion **214** from the outer periphery **198** towards the platform **200**. The sloped portion **214** allows for a greater volume of air adjacent the outer opening **160** of the of the fan housing **140** and adjacent the sink wall **202**, thus improving efficiency of air entering the fan housing **140** while preventing the outer periphery **198** of the heat sink **192** from being positioned to far from the surface to which it is mounted. As previously noted, when the fan housing **140** is coupled to the heat sink **192**, the end walls **142** of the fan housing **140** are positioned between the sink wall **202** and the outer periphery **198** of the heat sink **192** with the outer opening **160** of the fan housing **140** being positioned over a portion of the heat sink **192**. This allows air to be drawn into the fan housing **140** from the area adjacent the sink wall **202** through the outer opening **160** of the fan housing **140**.

One or more embodiments of a heat sink **192** further comprise one or more outer ribs **210** positioned on the inner surface **196** of the sloped portion **214**. The outer ribs **210** are typically positioned to improve airflow **213** through the air intake opening **212** and into the outer opening **160** of the fan housing **140**. One or more embodiments of a heat sink **192** further comprise a plurality of arced ribs **216** protruding from the platform **200**. The arced ribs **216** are positioned to enhance airflow as the fan **164** directs air onto the platform **200**, thus improving the efficiency of cooling of the heat sink.

Various embodiments of a LED lighting assembly **190** further comprise a mounting ring **220** (shown in FIGS. **23** and **25**) configured to removably couple to the heat sink **192** and also removably couple the LED lighting system **190** to a J-Box **50**. According to some aspects, a mounting ring **220** comprises a fan housing opening **222**, one or more screw holes, a protruding ring **226**, and an inner periphery **228** surrounding the fan housing opening **222**.

The fan housing opening **222** of the mounting ring **220** is typically sized to allow at least a portion of the fan housing **140** to fit within the fan housing opening **222**. As noted elsewhere, the fan housing opening **222** is bordered by an inner periphery **228** that is positioned and configured to interface with one or more mounting tabs **206** of a heat sink **192** to removably couple the heat sink **192** to the mounting ring **220**. In some embodiments, the inner periphery **228** comprises a lip protruding from a surface of the mounting ring **220**. A protruding ring may also extend from a surface of the mounting ring **220**, the protruding ring being positioned to interface with one or more of the spacing tabs **208** of the heat sink **192**.

One or more embodiments of a mounting ring **220** further comprise a plurality of screw holes. The mounting ring **220** typically comprises at least two first screw holes **223** positioned to align with two screw holes of a first sized J-Box **50** to allow easy and convenient coupling of the mounting ring **220** to the J-Box **50**. The mounting ring **220** may further comprise at least two second screw holes **224** positioned to align with two screw holes of a second sized electrical junction box. The mounting ring **220** may further comprise at least two third screw holes **225** positioned to align with two screw holes of a third sized electrical box. Thus, the mounting ring **220** is configured to allow coupling of the LED lighting system **190** to a variety of sized electrical junction boxes common in the art of junction boxes. The mounting ring **220** may further comprise additional screw holes positioned to align with screw holes on any of the heat sinks disclosed herein to removably couple the respective heat sink to the mounting ring **220**. It is further contemplated that spacing tabs **208** may extend from the outer surface of the mounting ring in alternative or addition to the spacing tabs **208** of the mounting ring **220**.

Embodiments of a LED lighting assembly **190** further comprise an air intake opening **212**. According to some aspects, one or more air intake openings are formed between the heat sink **192** and the mounting ring **220** when the heat sink **192** and the mounting ring **220** are coupled together. More particularly, one or more air intake openings are formed between the inner surface **196** of the heat sink **192** and the outer surface of the mounting ring **220**. Positioning of the spacing tabs **208** extending from the inner surface **196** of the heat sink **192** may assist in direct air flow through the LED lighting system **190** upon activation of the fan **164**.

FIG. **28** depicts a cross-sectional view of a non-limiting embodiment of a LED lighting assembly **190** coupled to a J-Box **50**, and FIG. **29** depicts a cross-sectional view of a non-limiting embodiment of a LED lighting assembly **190** coupled to a J-Box **50** and mounted to a flat surfaced **51**. In operation, the LED light system **190** improves the cooling efficiency of the system in comparison to conventional LED lighting systems. When a fan **164** in the LED lighting system **190** is activated, airflow **213** typically enters the system through the plurality of air intake openings **212** on the heat sink **192** and passes into the outer openings **160** of the fan housing **140**. Once within the fan housing **140**, air passes through the fan housing apertures **162** and the airflow **205** is exhausted from the system through the air exhaust openings **204** on the heat sink **192**.

Like other embodiments contemplated and disclosed herein, embodiments of a LED lighting assembly **190** are configured to mount to a flat surface **51** having a J-Box **50** mounted thereto. FIG. **29** depicts an exemplary implementation of this configuration. More particularly, according to some aspects, the mounting ring **220** may be mounted to the flat surface by coupling the mounting ring **220** to a J-Box **50**. In one or more embodiments, the mounting ring **220** is coupled to the J-Box **50** with screws extending through one or more of the screw holes in the mounting ring **220** and the J-Box **50**. Before or after coupling the mounting ring **220** to the electrical box, the fan housing **140**, coupled to a heat sink **192**, may be partially inserted into the fan housing opening **222** of the mounting ring **220**. Wires within the J-Box **50** may be operably coupled to the circuit board **168** of the fan housing cover **168** at any point, as will be apparent to one having ordinary skill in the art.

FIGS. **30-38** depict various other non-limiting embodiments of a fan cooled LED lighting system **230**. As depicted in the exploded perspective view of FIG. **38** and according to some aspects, an LED lighting system **230** comprises a heat sink **232**, one or more LEDs coupled to an outer surface **234** of the heat sink **232**, an LED cover **231** coupled to an outer surface **234** of the heat sink **232**, a fan housing **250** coupled to the heat sink **232** opposite the LED **5**, and a cover **270** coupled to the fan housing **250** distal the heat sink **232**. In one or more embodiments, the cover **270** threadedly couples to a threaded portion **243** of the heat sink **232**. An O-ring **241** may be utilized to improve the seal between the heat sink **232** and the cover **231**.

FIG. **35** depicts a rear view of a non-limiting embodiment of a heat sink **232**. In one or more embodiments, a heat sink **232** comprises a plurality of ribs **242** extending from an outer periphery **238** of the heat sink **232** towards a center **240** of the heat sink **232**. In some embodiments, the plurality of ribs **242** extend all the way from the outer periphery **238** of the heat sink **232** to the center **240** of the heat sink **232** where they meet at a raised center portion. In other embodiments, the plurality of ribs **242** extend only part way from the outer periphery **238** toward the center **240** of the heat sink **232**. In still other embodiments, the plurality of ribs **242** extend only part way between the outer periphery **238** and the center **240** of the heat sink **232**. According to some aspects, the plurality of ribs **242** may be either arced or straight.

One or more embodiments of a heat sink **232** further comprising a plurality of coupling posts **246**. According to some aspects, the plurality of coupling posts **246** extend from the inner surface **236** of the heat sink **232**. According to other aspects, the plurality of coupling posts **246** each extend from a different on of the plurality of ribs **242**. The coupling posts **246** are configured to couple the heat sink **232** to the fan housing **250**. In some embodiments, each coupling post **246** comprises a head configured to engage with a receiver on the fan housing **250**.

FIG. **33** depicts a front view of a non-limiting embodiment of a heat sink **232**. Embodiments of the heat sink **232** may comprise any of a variety of shapes. In the non-limiting embodiment depicted in FIG. **33**, the heat sink **232** comprises a substantially circular shape having a first diameter **248**.

One or more embodiments of a LED lighting system **230** further comprise a fan housing **250** coupled to the heat sink **232** opposite the LED **5**. FIGS. **34** and **36** depict a front and rear view, respectively, of a non-limiting embodiment of a fan housing **250**. The fan housing **250** is typically coupled to the heat sink **232** at a first end **252** of the fan housing **250**. The fan housing **250** may be coupled to the heat sink **232** through any coupling mechanism known in the are, such as but not limited to threaded coupling, screws, adhesives, posts, and the like. In the particular non-limiting embodiment depicted in FIGS. **30-33**, the fan housing **250** is coupled to the heat sink **232** with the coupling posts **246** extending from the heat sink **232**. In such embodiments, each coupling post **246** extends through a post hole in the base of the fan housing **250** and engages with a post receiver on the fan housing **250**. According to some aspects, a head of the post coupling **246** engages with a slotted or recessed post receiver on the fan housing **250**.

The fan housing **250** may comprise any of a variety of shapes and configurations. In the non-limiting embodiment depicted in FIGS. **34** and **36**, the fan housing **250** is substantially cylindrical in shape. In one or more embodiments, the fan housing **250** comprises a second diameter **266** at a first end **252** that is substantially equal to the first diameter **248** of the heat sink **232**.

One or more embodiments of a fan housing **250** further comprising at least one air intake opening **254** on an outer periphery **238** of the fan housing **250**. The air intake openings **254** are typically distal the heat sink **232** and extend through the fan housing **250** to allow fluid communication between the inside and outside of the fan housing **250**. In particular embodiments, the air intake openings **254** extend through an angled portion **264** of the fan housing **250**. Positioning the air intake openings **254** on an angled portion **264** creates a greater surface area of each of the air intake openings **254**, thus allowing more air from outside the fan housing **250** to be brought into the fan housing **250** upon activation of the fan **164**.

Coupling of the fan housing **250** to the heat sink **232** creates one or more air exhaust openings **244** between the first end **252** of the fan housing **250** and the outer periphery **238** of the heat sink **232**. FIG. **37** depicts a cross-sectional view of a non-limiting embodiment of a LED lighting system **230**. Responsive to activation of the fan **164** in the fan housing **250**, airflow **255** enters the fan housing **250** through the air intake openings **254** and across a portion of the heat sink **232**. Airflow **245** exits the LED lighting system **230** through the plurality of air exhaust openings **244**. Positioning of the arced ribs **242** on the heat sink **232** may more efficiently direct air to the air exhaust openings **244** on the outer periphery **238** of the heat sink **232**.

One or more embodiments of a LED lighting system **230** further comprise a cover coupled a second end **253** of the fan housing **250** distal the first end **252**. FIGS. **30-32** depict perspective views of LED lighting systems coupled to different covers. In FIG. **30**, the cover **270** comprises a threaded portion **272** configured to removably couple the LED lighting system **230** to the base of a common jelly jar light. The cover **270** further comprises a fitting element **278**. The fitting element **278** is configured to operably couple to the power source in the base of the jelly jar light and is operably coupled to the LED **5** and the fan **164**. According to some aspects, the fitting element **278** comprising a spring coupling the couples to the sides walls of the power source of the base of the jelly jar light, and a pogo-pin on the fitting element may further couple to the bottom of the power source of the base of the jelly jar light. The two then combine to make a complete electrical circuit that brings power to the LED lighting system **230**.

FIG. **31** depicts another embodiment of a cover **280** for use in a LED lighting system **230**. According to some aspects, a cover **280** is substantially planar on a rear surface and is adapted to couple to a flat surface or a J-Box **50**. Accordingly, screws **282** are configured to extend through the cover **280** to removably couple the cover **280** and LED lighting system **230** to a J-Box **50** and or a flat surface. The screws may be inserted prior to coupling of the housing **250** to the cover **280** or, alternatively, the dividing wall **258** may comprise openings that allow access to the screws **282**. The cover **280** may comprise a hole or other wiring to allow for operably coupling of the LED lighting system to a power source.

FIG. **32** depicts another embodiment of a cover **284** for use in a LED lighting system **230**. One or more embodiments of a cover **284** comprise a fitting element **286** configured to operably and removably couple to the LED lighting system **230** to a conventional light bulb socket.

Coupling of the various covers **270**, **280**, **284** to the fan housing **250** may be through any mechanism known in the art, such as but not limited to threaded coupling, adhesives, screws, pins, and the like. In the non-limiting embodiment depicted in FIG. **38** the cover **270** comprises a plurality of tab receivers **274** configured to receiver a plurality of tabs **268** on the fan housing **250** to couple the fan housing **250** to the cover **270**. The covers **280** and **284** may include similar tab receivers **274**. According to some aspects, the tabs **268** are proximate the second end **253** of the fan housing **250**. The tab receivers **274** may comprise any configuration for receiving the tabs **268** and to hold the cover **270** either temporarily or permanently in place. The covers **270**, **280**, **284** may be configured to be interchangeable with the LED lighting system **230**, thus allowing a user to adapt the LED lighting system **230** for particular uses.

Typically housed within the fan housing is a fan **164**. The fan **164** may comprise any fan known in the art. In the non-limiting embodiment depicted in FIG. **36**, the fan **164** is mounted to a dividing wall **258**. The dividing 258 is configured to position the fan **164** within the fan housing **250** such that the fan **164**, when activated, may draw air into the fan housing **250** through the air intake openings **254** and exhaust air through the air exhaust openings **244**. According to some aspects, the dividing wall **258** comprises a sloped body **260** and a rim **262**. The sloped body **260** is typically partially conical in shape the rim **262** is typically circular or cylindrical in shape. In such embodiments, the fan **164** is typically mounted to fit within the rim **262**, the fan being supported by a fan mount **261**. In operation, embodiments of the LED lighting system **230** are configured to efficiently draw air into the fan housing **250** through the air intake openings **254**, then blow that air onto the heat sink **232** before air is finally exhausted through the air exhaust openings **244**. In so doing, the LED lighting system **230** is cooled more efficiently than conventional LED lighting assemblies.

It is noted that throughout this disclosure, reference is made to various air intake openings and air exhaust openings. Also contemplated in this disclosure, however, are systems wherein the direction of air flow is reversed dependent upon the rotational direction of the fan. Thus, it is understood that any air exhaust opening may also be air intake openings, and any air intake openings may be air exhaust openings.

FIG. **2**A is a schematic diagram that shows an embodiment of an LED light bulb device or LED device **40** according to an embodiment of the present disclosure. LED device **40** includes an AC/DC convertor further comprising an AC LED Driver integrated circuit (IC) or semiconductor chip **42**. AC LED Driver IC **42** includes a line input **44** and a neutral input **46**. The line input **44** and neutral input **46** can receive a standard AC voltage, such as 120 volts from a standard US electrical socket. AC LED Driver IC **42** converts the AC voltage to a desired DC output, such as 4 volts, 12 volts, or any other desired voltage, at output **48**. LED Driver IC **42** converts the AC voltage across inputs **44** and **46** to a DC voltage at output **48** by employing a bank switching scheme that effectively "chops up" the AC input signal by processing discrete portions of the AC signal with respect to a time domain of the signal. By using the "chopped" AC signal from inputs **44** and **46**, LED Driver IC **42** functionally replaces a much larger number of hardware components that might otherwise be used to accomplish an AC/DC conversion such as is required by a conventional AC/DC converter. Specifically, a single semiconductor chip can replace on the order of 50 or more components that would be required by a conventional AC/DC converter to provide similar functionality, thereby greatly simplifying the circuitry for LED device **40**. As a non-limiting example, LED Driver IC **42** may include, without limitation, such chips as the chip of part number DT3001A/B by Digital Media Bridge Technology Co., Ltd. (DMB). DMB chip DT3001A/B is used, for example, by SEOUL Semiconductor as part of a bank switching scheme that effectively "chops up" an AC input signal to provide a desired output signal to an array or plurality of LEDs as used in Acrich Semiconductor Eco Lighting, such as the Acrich 4 W, 8 W, and 12 W Acrich 2 modules. Use of bank switching for an LED lighting module is disclosed in U.S. Pat. No. 7,081,722 to Huynh, et al, titled "LIGHT EMITTING DIODE MULTIPHASE DRIVER CIRCUIT AND METHOD," as well as U.S. Pat. No. 7,439,944, to Huynh, et al, titled "LIGHT EMITTING DIODE MULTIPHASE DRIVER CIRCUIT AND METHOD," the entirety of the disclosures of which are incorporated herein by this reference.

Advantageously, use of AC LED Driver IC **42** in place of a conventional AC/DC convertor comprising numerous hardware components also increases reliability of the AC/DC conversion process. For example, conventional AC/DC convertors may include buck convertors, boost convertors, buck boost converters, H Bridge converters, SEPIC converters, Flyback converters, and a number of capacitors, transformers and inductors, each of which includes a functional life-time. Elements of a conventional AC/DC convertor can fail after a period of normal use also causing the convertor to fail. For example, conventional AC/DC convertors can receive repeated spikes in voltage during normal operation. The spikes in voltage can be reduced or smoothed for the convertor by capacitors, which can fail after receiving repeated spikes in voltage. Thus, by using AC LED Driver IC **42** in place of a conventional AC/DC convertor as part of LED device **40**, a simpler, more reliable, and less expensive solution is available.

FIG. **39**A further shows a number of LEDs **350** are coupled to AC LED Driver IC **42** at output **48** to receive a desired DC voltage for powering LEDs **350**. LEDs **350** may be a single LED or a plurality of LEDs arranged in an array comprising multiple banks of LEDs connected in series or in parallel, as discussed in greater detail below with respect to FIG. **40**. Additionally, FIG. **39**A shows a DC powered variable speed fan **52** that is coupled to output **48** of AC LED Driver IC **42** and is further coupled in parallel with at least one LED **350**. The design of LED device **40** is conducive to the use of DC powered fans, which are typically commercially available as fans with a longer service lives than commercially available AC fans. In an embodiment, fan **52** is a fan produced by Sunon, Inc. The design of LED device **340** advantageously provides DC power for both LEDs **350** and fan **52** using the same AC LED Driver IC **42**; thereby increasing efficiency by eliminating the redundancy of multiple AC/DC convertors for a single LED device, such as may be required by certain conventional designs. Additionally, by coupling fan **52** in parallel with LEDs **350**, instead of coupling the fan at a separate output of an AC LED Driver IC as is common with certain prior art designs, the voltage of fan **52** may vary as a voltage of LEDs **350** varies. A voltage to LEDs **350** may vary to increase a brightness or amount of light emitted by the LEDs. For example, LEDs **350** may be tied to a dimmer or have a dimmer functionality such that as voltage is increased a brightness of LEDs **350** is also increased to accommodate user preference. When fan **52** is coupled in parallel with LEDs **350**, a voltage to variable speed fan **52** may also vary, to increase or decrease a speed at which the fan operates. For example, as the brightness of LEDs **350** is varied, such as by a dimmer, because LEDs **350** and variable speed fan **52** are coupled in parallel and share the same voltage, the speed of fan **52** varies directly with a brightness of LEDs **350**. Advantageously, the increased brightness and heat from LEDs **350** is directly related to the speed of fan **52** and an amount of heat dissipated from LED device **340** by the fan so that the more heat is generated by LEDs **350**, the more heat is dissipated by fan **52**. Significantly, the direct relationship between heat generated by, and heat conducted away from, LED device **340** results from connecting LEDs **350** and fan **52** in parallel without the additional expense, complexity, and cost of adding additional components or circuitry to the LED device. Thus, the functionality of controlling the speed of fan **52** to accommodate changing thermal conditions of LEDs **350** may be “free” because variation of fan speed can operate without any circuitry or components in addition to those used for the operation of LEDs **350**.

FIG. **39**B is a schematic diagram that shows an embodiment of an LED light bulb device or LED device **56** similar to LED light bulb device or LED device **340** from FIG. **39**A. LED device **56** differs from LED device **340** by inclusion of optional filter **58**. Filter **58** may include a number of capacitors and provides a stable voltage to fan **52** that may reduce or effectively eliminate undesired ripple effects and may also provide a voltage to fan **52** different from the voltage provided to LEDs **350**, if desired. In one embodiment, a voltage of between 11.8-12.2 V may be used depending upon the fan being used for the design. However a different voltage could equivalently be used for a different fan, or if the forward voltage of the LEDs used is changed. Those of ordinary skill in the art will readily understand how to modify

FIG. **40** is a schematic diagram that shows an embodiment of an LED circuit module **360** coupled to circuitry **61** and fan **372** in an arrangement similar to LED light bulb device or LED device **56** from FIG. **39**B. LED circuit module **360** includes an AC/DC convertor further comprising an AC LED Driver IC, semiconductor chip, or IC **362** similar to AC LED Driver IC **42**. IC **362** may be coupled to a line input **64** and a neutral input **66** that provide power for LED circuit module **360**. Line input **64** and neutral input **66** may receive a standard AC voltage, such as 120 volts from a standard US electrical socket. IC **362** converts the AC voltage to a desired DC output, such as 4 volts, 12 volts, or any other desired voltage, at a number of output interconnects or pins. IC **362** may include any number of input/output pins or interfaces, and in a non-limiting embodiment comprises twelve pins, P**1** to P **12**. As described above with respect to AC LED Driver IC **42**, IC **362** may convert the AC voltage across inputs **64** and **66** to a DC voltage by employing a bank switching scheme that effectively “chops up” the AC input signal by processing discrete portions of the AC signal with respect to a time domain of the signal. By using the “chopped” AC signal from inputs **64** and **66**, LED Driver IC **362** functionally replaces a much larger number of hardware components that might otherwise be used to accomplish an AC/DC conversion such as is required by a conventional AC/DC converter. Specifically, a single semiconductor chip may replace on the order of 50 or more components that would be required by a conventional AC/DC converter to provide similar functionality, thereby greatly simplifying the circuitry for LED circuit module **360**. As indicated above, IC **362** may include the chip of part number DT3001A/B by DMB that is used by SEOUL Semiconductor as part of its Acrich Semiconductor Eco Lighting hardware. Advantageously, use of IC **362** in place of a conventional AC/DC convertor comprising numerous hardware components also increases reliability of the AC/DC conversion process.

FIG. **40** further shows a number of LEDs **370** are arranged as a grid or array comprising a number of banks or rows B**1** to B**6**, although any number of banks or rows comprising LEDs **370** arranged in series or parallel may be formed. One or more banks B**1** to B**6** of LEDs **370** are coupled to a number of pins P**1**-P**12** of IC **362** such that LEDs **370** are configured to alternately receive a desired DC voltage from IC **362** for powering LEDs **370**. For example, banks B**1** and B**2** may be coupled to P**4**, P**5**, and P**11** of IC **362**, banks B**3** and B**4** may be coupled to P**10** and P**11** of IC **362**, bank B**5** may be coupled to P**9** and P**10** of IC **362**, and bank B**6** may be coupled to P**8** and P**9** of IC **362**. By controlling an amount and time for which the DC voltage is alternatingly applied across the various pins of IC **362**, banks of LEDs **370** are alternately illuminated. While LEDs **370** are shown in FIG. **40** as organized in parallel rows or banks, LEDs **350** may also be serially arranged and/or packaged in groups that appear to be single lights, which are in reality, composed of a group or number of LEDs **350**. In an embodiment, each bank of LEDs may be independently controlled by IC **362**, which allows for more control over the operation of LEDs **370** than would otherwise be available with a more complex AC/DC conversion circuit that did not use an IC like IC **362**. Because the banks of LEDs **370** are alternately turned on and off, during normal operations, an entirety of the lights is not on at a same time. However, the switching on and off of LEDs **370** may occur so quickly that a user does not perceive any flickering or perceive that LEDs **370** are being turned on and off, and instead perceives that the entirety of LEDs **370** are continuously activated or on. By using IC **362** to vary an electrical load supplied to a combination of banks B**1**-B**6**, arranged in series or parallel, a high power factor can be achieved for LEDs **370** in banks B**1**-B**6**. As known in the art, a power factor is a dimensionless unit used to describe a ratio of: real power flowing to the electrical load/apparent power; wherein real power is a circuit’s capacity for performing work and apparent power is the product of the current and voltage of the circuit. In an embodiment, a power factor in a range of 0.9-1.0 is achieved by using IC **362** as described above.

Additionally, FIG. **40** shows a DC powered variable speed fan **372**, similar to fan **52** from FIGS. **39**A and **39**B, coupled to bank B**5** of LEDs **370** and further coupled to pins P**9** and P**10** of IC **362**. By coupling fan **372** in parallel with at least one LED **370** the design of LED circuit module **360** advantageously provides DC power for both LEDs **370** and fan **372** using the same IC **362**; thereby increasing efficiency by eliminating the redundancy of multiple AC/DC convertors for a single LED device. Additionally, by coupling fan **372** in parallel with bank B**5** of LEDs **370**, the voltage of fan **372** may vary as a forward voltage to LEDs **370** varies. A voltage to bank B**5** of LEDs **370** may vary to increase a brightness or amount of light emitted by the LEDs. For example, LEDs **370** may receive a voltage from IC **362** that varies to dim or brighten LEDs **370** to accommodate user preference. Because LEDs **370** are coupled in parallel with fan **372**, a voltage to variable speed fan **372** may also vary, to increase or decrease a speed at which the fan operates. For example, as the brightness of LEDs **370** is varied, because LEDs **370** and variable speed fan **372** are coupled in parallel and share the same voltage, the speed of fan **372** varies directly with a brightness of LEDs **370**. Advantageously, the increased brightness and heat from LEDs **370** is directly related to the speed of fan **372** and an amount of heat dissipated from LED circuit module **360** by the fan so that when more heat is generated by LEDs **370**, more heat is dissipated by fan **372**. Significantly, the direct relationship between heat generated by, and heat conducted away from, LED circuit module **360** results from coupling LEDs **370** and fan **372** in parallel. Thus, the functionality of controlling the speed of fan **372** to accommodate changing thermal conditions of LEDs **370** may be "free" because variation of fan speed may operate without any additional, or only nominal, circuitry and components in addition to those used for the operation of LEDs **370**. In an embodiment, the forward voltage of LEDs **370** may be approximately 24 volts and fan **372** is rated for 24 volts. In another embodiment, LEDs **370** may operate at a switching forward voltage peaking at a range of approximately 18-20 volts and a filter, such as filter **78** described in greater detail below, may be used to change the switching forward DC voltage from 18-20 volts to a DC voltage of approximately 12 volts.

Additionally, conventional LED light devices typically are made such that all the LEDs are connected or tied off together, whether in series or in parallel, so if an additional component such as fan **372** were coupled to the LEDs, the electrical current drawn by the component would reduce electrical current available for the connected group of LEDs, thereby sacrificing performance of the LEDs. To the contrary, by dividing the plurality of LEDs **70** into separate banks of LEDs that are independently controlled by IC **362**, drawing power from one bank of LEDs, such as B**5**, does not adversely affect the performance of adjacent banks of LEDs in a significant or substantial way, although some nominal change in current and/or voltage may occur in surrounding banks of LEDs. Thus, the banks of LEDs may be arranged such that a voltage that would otherwise be supplied to a portion of the LEDs may be directed to power fan **372** by tapping off one bank of LEDs **70** to provide power to fan **372**. Therefore, in a non-limiting exemplary embodiment, modification of IC **362** for use with multiple banks of LEDs **370** requires a small number of parts (approximately 5-10 parts) and requires a small cost for parts (approximately $0.05-$0.20).

FIG. **40** further shows LED circuit module **360** may optionally include a filter **78**, similar to filter **58** in FIG. **2**B. Filter **78** is coupled between bank B**5** of LEDs **370** and fan **372**, and may optionally include a diode Dl, a resistor R**1**, and a number of capacitors C**1**-C**4**. Resistor R**1** may be used to adjust a voltage supplied to fan **372** as part of filter **78**. The supply voltage to fan **372** is based on the forward voltage of LEDs **370** to which the fan is coupled, for example bank B**5** of the LEDs. Accordingly, an operating voltage of LEDs **370** and fan **372** may be matched and may correspond one to another. For example, if the forward voltage of LEDs **370** is 24 volts, a 24 volt rated fan **372** may be selected. Similarly, LEDs operating at 12 volts may be paired with a 12 volt rated fan. In some embodiments, an optimal operating voltage for LEDs **370** will be different from an optimal operating voltage of fan **372**, in which case allowance should be made for the differences in voltage by adjusting the voltage between LEDs and the fan by inserting a resistor, such as R**1**, between the LEDs and the fan. In a particular embodiment, LEDs **370** operate at a peak switching forward voltage in a range of approximately 18-20 volts and fan **372** is rated to operate at approximately 12 volts, so that filter **78** including resistor R**1** is used to change the DC voltage of 18-20 volts at B**5** of LEDs **370** to a voltage of about 12 volts at fan **372**. In an embodiment, resistor R**1** may have a resistance sized to meet the current requirements of the fan. In a particular embodiment, resistor R**1** may have a value of about 150 ohms and is selected so the fan will see between 20 mA and 27 mA of average DC current. The current value needed is determined by the fan manufacture specifications. Thus, LED circuit module **360** may be designed to supply a particular voltage to fan **372**, or fan **372** may be selected such that the fan will accommodate the voltage supplied to LEDs **370**.

Filter **78** may also include a number of capacitors that ensure a constant or acceptable voltage is supplied to fan **372** while a voltage is intermittently and alternately supplied to banks B**1**-B**6** of LEDs **370** by IC **362**. Capacitors C**1**-C**4** may be placed within fan **372** and integrally formed as part of a single unit, or alternatively, may be placed outside fan **372** and positioned elsewhere within LED circuit module **360**, or within circuitry **61**, such as when a size of the capacitors is too large to be accommodated within a housing of the fan. In an embodiment, filter **78** may include four capacitors, C**1**-C**4**, that each have a capacitance in a range of about 12-25 microfarads, and are connected in parallel with resistor R**1** and fan **372**. Because LEDs **370** are not all on at a same time, and fan **372** draws its power from only a portion or bank of the LEDs, fan **372** could, undesirably, receive only intermittent power and thus rapidly switch on and off as IC **362** alternately supplied power to banks B**1**-B**6** of LEDs **370**. Providing capacitors as part of filter **78** allows an electrical charge to be stored in the capacitors by drawing electrical current from a bank of LEDs when the bank of LEDs is receiving a voltage from IC **362**. Then, when the bank of LEDs to which fan **372** is coupled is not receiving power from IC **362**, the capacitors may release a portion of the stored charge to fan **372**, such that fan **372** has a constant or sufficient voltage supply so that the fan may operate uninterrupted and continuously conduct heat from the array of LEDs **370** while IC **362** performs its bank switching.

Providing capacitors as part of filter **78** also allows a stable voltage to be provided to fan **372** by eliminating undesired ripple effects within LED circuit module **360**. A ripple effect is the small unwanted residual periodic variation of the DC output of IC **362** that results from the input of an AC power source at inputs **64** and **66**. The ripple effect is due to an incomplete suppression of the alternating waveform within IC **362**. Thus the cycling of LED banks B**1**-B**6** from the alternating voltage supply from IC **362** may cause a ripple effect from the cycling of banks B**1**-B**6** and the turning on and off of LEDs **370**. The presence of some ripple effect will not adversely affect operation of fan **372**, and the fan will continue to operate in normal ranges. However, excessive ripples will decrease performance of fan **372**, thereby reducing both an ability of the fan to transfer heat away from LEDs **370** and reducing an overall life of fan. As described above, inclusion of capacitors within filter **78** between fan **372** and a bank of LEDs serves to maintain a stable voltage, which eliminates excessive ripple effect and improves fan performance and increases fan lifetime.

FIG. **40** also shows additional circuitry **61** that may optionally be coupled to LED circuit module **360** and fan **372**. Circuitry **61** may comprise a number of optional resistors, capacitors, diodes, and other devices according to the function and design of a final LED device. In an embodiment, circuitry **61** comprises a thermal switch or thermocouple **380**. Thermal switch **380** operates as a cut off switch that will stop operation of LED circuit module **360** if too much heat accumulates within the LED device and threatens to overheat and or damage LEDs **370** or other components of the LED device. For example, if fan **372** breaks or ceases operation and the LED device begins to accumulate dangerous levels of heat, then thermal switch **380** will respond to the increased temperature of the LED device by stopping IC **362** from powering LEDs **370** such that excess heat dissipates and LED circuit module **360** is not damaged.

FIG. **40** further shows a WiFi module or interface **384** included as part of circuitry **61**. WiFi module **384** is coupled to AC inputs **64** and **66** as well as to IC **362**. In an embodiment, WiFi module **384** may include a WiFi module from Microchip (Roving Networks), part number RN-717. This WiFi module uses a separate microcontroller that may be programmed to interface with a WiFi home system or any other WiFi system. However, other WiFi modules from this and other manufacturers are sufficient for this and other embodiments. WiFi module **384** may be removably attachable to circuitry **61** such that the WiFi module is optionally attached, for example, by being snapped into place. WiFi module **384** can advantageously provide dimming functionality to LEDs **370** by controlling or providing input signals to IC **362** that allow for direct access to LEDs **370** through the WiFi interface. The WiFi interface can be accessed and controlled by a user through a computer, a portable handheld electronics device such as a phone or tablet, and through other suitable devices, thereby eliminating a need for dimmer modules previously used in the art.

While WiFi or radio connections have been previously put into lights, conventional lights with WiFi connections have included a total size or volume that was too large to fit within standard size ceiling J-Boxes. For example, in the Unites States a standard round ceiling J-Box includes a diameter in a range of about 5.0-8.44 centimeters (cm) (or about 2.0-3.375 inches) and a depth of about 2.5-6.875 cm (or about 1.0-2.75 inches) for a total interior volume of about 78-490 cubic centimeters (or 4.0-31.3 cubic inches). Thus, conventional lighting devices with WiFi control were suitable for applications involving can lighting, but had volumes that were prohibitive of use in smaller applications such as use in standard J-boxes as described above. To the contrary, some embodiments of disclosed LED circuit modules **360**, circuitry **61** including WiFi module **384**, and fan **372**, taken together, are small enough to fit in a standard sized junction box while emitting as much light as would be emitted by a conventional 100 Watt incandescent bulb.

FIG. **40** further shows an electrical bridge **386** may optionally be included as part of circuitry **61**. Bridge **386** may be coupled between inputs **64** and **66** and LED module circuit **360** to convert the alternating current (AC) power source to a direct current (DC) power source. Bridge **386** may comprise four diodes configured in a bridge configuration. Bridge **386** may be sized to meet the current requirements of the designed load, which in an embodiment, can be about 12-15 Watts. In another particular embodiment, a 500 mA part is used, which exceeds the lower required 90 mA and 125 mA.

FIG. **41** shows a perspective view of LED device **98** comprising circuitry **61** and circuit module **360** described above with respect to FIG. **40** disposed within a standard sized ceiling J-Box **400**. A face plate **102** and a base plate **104** comprising vents **105** are disposed over and connected to J-Box **400** with screws **106**. A lens **108** is attached to base plate **104** and comprises a translucent material that allows passage of light generated by LEDs **370** to pass through the lens while the lens protects LEDs **370**. Vents **105** in base plate **104** increase airflow and permit fan **372** to circulate air around LEDs **370** to cool LED circuit module **360** and LED device **98**. By building LED circuit module **360** and circuitry **61** with a volume less than a volume of J-Box **400**, LED circuit module **360** may be installed in desired lighting applications by being disposed within J-Box **400** rather than being housed within larger more expensive can lighting that requires additional effort, time, and expense for installation. By installing LED circuit module **360** in J-Box **400** instead of in a can lighting fixture, LED circuit module **360** may be packaged to be much lighter than can lighting and also avoid direct exposure to higher attic temperatures, being instead exposed to cooler temperatures of a room the LED device is lighting, thereby improving thermal performance.

While FIG. **41** shows only a single LED device **98** comprising J-Box **400**, a number of LED devices **98** may be electrically connected in series or parallel to form a number of interconnected lighting devices, or a "daisy chain" of LED devices. Interconnected LED devices **98** may be used for lighting rooms and areas requiring more than a single unit and may operate as part of a larger lighting system.

FIG. **42** shows a cross-sectional view of LED device **98** taken along section line **5-5** shown in FIG. **41**. The left side of FIG. **5** shows elements disposed at the exterior of LED device **98** that were shown previously in FIG. **4**, such as J-Box **400**, face plate **102**, base plate **104**, screw **106**, and lens **108**. FIG. **5** further shows a flash mount insulator **101** disposed between J-Box **400** and both face plate **102** and base plate **104**. FIG. **5** further shows a cut-away view of LED device **98** by removal of a portion of J-Box **400**, flash mount insulator **101**, face plate **102**, and base plate **104** to reveal interior elements of LED device **98**. The exterior elements of LED device **98** shown on the left side of FIG. **5** are removed from the right side of FIG. **5** to show features disposed within the LED device and internal to the exterior elements. For example, FIG. **5** shows LEDs **370** and IC **362** are mounted to a substrate **412** that may be disposed within J-Box **400**, over fan **372**, over WiFi module **384**, and below lens **108**. Thus, light emitted from LEDs **370** can pass unobstructed through lens **108**.

FIG. **42** also shows a shroud cover or housing base **414** disposed within J-Box **400**. Housing base **414** may be made of plastic, metal, fiberglass, ceramic, composite material, or other suitable material that provides a structural base to which fan **71** and WiFi module **84** may be connected. A printed circuit board (PCB) containing circuitry **61** may also be coupled or mounted to housing base **414** below fan **372**.

LED device **98** further comprises a fan shroud or housing **116** that may be made of plastic, metal, fiberglass, ceramic, composite material, or other suitable material. Fan shroud or housing **116** is coupled to, and extends between, perimeter portions of substrate **412** and housing base **414**. Housing **116** is disposed around fan **372** and forms a space or area **117** in which the fan can circulate air to cool LEDs **370** and LED device **98**. Taken together, substrate **412** comprising IC **362** and LEDs **370**, fan **372**, housing base **414**, and housing **116** form a module **118** that may have a height less than a height of J-Box **400**.

FIG. **43** shows a perspective view of an LED device **420** that is similar to LED device **98** shown in FIG. **41**. Like LED device **98**, LED device **420** may comprise circuit module **360**, circuitry **61**, and fan **372**, disposed within a standard sized housing **122**. Housing **422** may be made of plastic, metal, fiberglass, ceramic, composite material, or other suitable material. Housing **422** may contain or surround module **118**, the module having a height less than a height of J-Box **400**. Housing **422** may be larger than, or enclose an area greater than, the area enclosed by housing **98** to match a shape, contour, or form factor or standard shaped or commercially available product, such as a Par **30** bulb. Because module **118** is smaller than J-Box **400** and housing **422**, the same module may be used in multiple different housings without modifying the shape and layout of the module. By using a single module design within multiple housings, greater efficiencies and lower costs may be achieved. Additional space created between module **118** and housing **422** may be shaped and used for air circulation and LED cooling. In an embodiment, housing **422** is shaped to expose at least a portion of WiFi module **384** at an exterior of LED device **420** for easy access that enables the optional addition and removal of the WiFi module.

FIG. **43** further shows LED device **420** may include a socket fitting **424** attached to an end of LED device **420** opposite lens **108**. Socket fitting **424** may be made of metal or other conductive material or combination of materials. Socket fitting **424** may be threaded to be removably attached LED device **420** to a standard light socket configured to receive conventional light bulbs and provide a voltage or electrical power supply to circuit module **360**.

Similar to FIGS. **41** and **42**, LED device **420** of FIG. **43** includes a base plate **104** comprising vents **105**, screws **106**, and lens **108**. Base plate **104** is disposed over and may be connected to housing **422** opposite socket fitting **424** with screws **106**. A lens **108** may be coupled to base plate **104** and housing **422** and comprises a translucent material that allows passage of light generated by LEDs **370** while protecting LEDs **370**. Vents **105** in base plate **104** increase airflow and permit fan **372** to circulate air around LEDs **370** to cool LED circuit module **360** and LED device **420**.

While FIG. **43** shows only a single LED device **420**, a number of LED devices may be electrically connected in series or parallel to form a number of interconnected lighting devices, or a "daisy chain" of LED devices **420**. Interconnected LED devices **420** may be used for lighting rooms and areas requiring more than a single unit and may operate as part of a larger lighting system.

It will be understood that implementations are not limited to the specific components disclosed herein, as virtually any components consistent with the intended operation of a method and/or system implementation for LED cooling systems may be utilized. Accordingly, for example, although particular fans, heat sinks, fan housings, LEDs, covers, and the like may be disclosed, such components may comprise any shape, size, style, type, model, version, class, grade, measurement, concentration, material, weight, quantity, and/or the like consistent with the intended operation of a method and/or system implementation for a LED cooling system may be used.

In places where the description above refers to particular implementations of an LED cooling system, it should be readily apparent that a number of modifications may be made without departing from the spirit thereof and that these implementations may be applied to other LED cooling system or assemblies. The accompanying claims are intended to cover such modifications as would fall within the true spirit and scope of the disclosure set forth in this document. The presently disclosed implementations are, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the disclosure being indicated by the appended claims rather than the foregoing description. All changes that come within the meaning of and range of equivalency of the claims are intended to be embraced therein.

The invention claimed is:

1. A light emitting diode (LED) lighting system, comprising:

one or more LEDs;

a heat sink coupled to the one or more LEDs, the heat sink comprising an outer periphery, a platform, two sink walls, and two air exhaust openings extending through the platform, each air exhaust opening positioned between a different sink wall of the two sink walls and the platform;

a fan housing coupled to the platform of the heat sink opposite the one or more LEDs, the fan housing comprising two opposing end walls each positioned between a different sink wall of the two sink walls and the outer periphery of the heat sink, two opposing sidewalls positioned between the two end walls, two opposing dividing walls coupled to the two opposing end walls and each comprising a terminating end aligned with and adjacent to a different one of the two sink walls, two outer openings positioned between a different end wall of the two end walls and a different dividing wall of the two dividing walls, a fan housing aperture within the fan housing positioned between the two dividing walls, and a cover coupled to the end wall opposite the heat sink;

a fan coupled to the fan housing and positioned at least partially within the fan housing aperture, wherein airflow enters the fan housing through the two outer openings, passes through the fan housing aperture to interface the heat sink, and exits through the two air exhaust openings responsive to activation of the fan.

2. The LED lighting system of claim **1**, wherein the fan housing includes a height in a range between 2.5-6.875 centimeters and includes a volume small enough to be housed within a standard single gang electrical junction box.

3. The LED lighting system of claim **2**, wherein the heat sink is configured to mount to a flat surface and the end walls, the sidewalls, and the dividing walls of the fan housing are integral with one another.

4. The LED lighting system of claim **3**, wherein the heat sink further comprises an outer wall at the outer periphery, a heat sink channel formed between the outer wall and each of the heat sink walls, and a plurality of air intake openings extending through the outer wall.

5. The LED lighting system of claim **4**, wherein the plurality of air intake openings are positioned within an angled portion of the outer wall and the heat sink further comprises a plurality of arced ribs extending from the platform toward the fan housing.

6. The LED lighting system of claim **5**, further comprising a bulb-like housing coupled to the heat sink such that the fan housing is housed within the bulb-like housing, the bulb like housing comprising an open first end coupled to the heat sink and a second end coupled to a socket fitting operably coupled to the one or more LEDs and the fan, wherein, responsive to activation of the fan, air flows into the LED light system through the air intake openings, through the two outer openings, through the fan housing aperture, and out the air exhaust openings, each air exhaust opening being separated from the air intake openings by at least the respective sink wall.

7. The LED lighting system of claim **3**, further comprising a mounting ring removably coupled to the heat sink, the mounting ring comprising one or more screw holes positioned to align with one or more screw mounts on a standard electrical junction box such that when the mounting ring is coupled to the standard electrical junction box, the fan housing is positioned within the standard electrical junction box and at least a portion of the mounting ring is adjacent a flat surface to which the standard electrical junction box is mounted.

8. The LED lighting system of claim **7**, further comprising:
- a plurality of spacing tabs on an inner surface of the sink between the heat sink and the mounting ring;
- an air intake opening formed between an outer surface of the mounting ring and the inner surface of the heat sink, wherein, responsive to activation of the fan, air flows into the LED light system through the air intake opening, through the two outer openings, through the fan housing aperture, and out the air exhaust openings.

9. The LED lighting system of claim **1**, wherein the lighting system further comprises a semiconductor chip comprising an input coupled to an AC power supply and further comprising a plurality of DC power outputs, wherein the one or more LEDs comprises a plurality of banks of LEDs coupled to the plurality of DC power outputs, and wherein the fan is further coupled in parallel with a first of the plurality of banks of LEDs.

10. A light emitting diode (LED) lighting system, comprising:
- one or more LEDs;
- a heat sink coupled to the one or more LEDs, the heat sink comprising a platform, a sink wall, and an air exhaust opening heat sink;
- a mounting ring coupled to the heat sink opposite the one or more LEDs, the mounting ring comprising one or more screw holes positioned to mount the LED lighting system to an electrical junction box mounted to a flat surface;
- a fan housing coupled to the platform of the heat sink opposite the one or more LEDs and sized to fit within a single gang electrical junction box, the fan housing comprising an end wall, a dividing wall coupled to the end wall and comprising a terminating end aligned with and adjacent to the sink wall, an outer opening positioned between the end wall and the dividing wall, a fan housing aperture within the fan housing, and a cover opposite the heat sink;
- a fan coupled to the fan housing and positioned at least partially within the fan housing aperture, wherein, responsive to activation of the fan, airflow enters the fan housing through the outer opening, passes through the fan housing aperture to interface with the heat sink, and the exits through the air exhaust opening of the heat sink.

11. The LED lighting system of claim **10**, wherein:
- the sink wall comprises two sink walls;
- the air exhaust openings comprise two air exhaust openings extending through the platform, each air exhaust opening positioned between a different sink wall and the platform;
- the end wall of the fan housing comprises two opposing end walls, the fan housing further comprising two opposing sidewalls positioned between the two end walls;
- the dividing wall of the fan housing comprises two opposing dividing walls each comprising a terminating end aligned with and adjacent to a different one of the two sink walls, the fan housing aperture being positioned between the two dividing walls; and
- the outer opening comprises two outer openings positioned between a different end wall of the two end walls and a different dividing wall of the two dividing walls.

12. The LED lighting system of claim **11**, wherein the dividing walls, the end walls, and the sidewalls of the fan housing are integral with one another, and wherein the heat sink further comprises an outer wall at an outer periphery, a heat sink channel formed between the outer wall and each of the heat sink walls, one or more screw holes, and a plurality of air intake openings extending through the outer wall.

13. The LED lighting system of claim **12**, wherein the plurality of air intake openings are positioned within an angled portion of the outer wall and the heat sink further comprises a plurality of arced ribs extending from the platform toward the fan housing.

14. The LED lighting system of claim **13**, further comprising a bulb-like housing coupled to the mounting ring such that the fan housing is housed within the bulb-like housing, the bulb like housing comprising an open end coupled to the heat sink and a closed end coupled to a socket fitting operably coupled to the one or more LEDs and the fan, wherein, responsive to activation of the fan, air flows into the LED light system through the air intake openings, through the two outer openings, through the fan housing aperture, and out the air exhaust openings, each air exhaust opening being separated from the air intake openings by at least the respective sink wall.

15. The LED lighting system of claim **12**, further comprising a mounting ring removably coupled to the heat sink, the mounting box comprising one or more screw holes positioned to align with one or more screw mounts on a standard electrical junction box such that when the mounting ring is coupled to the standard electrical junction box, the fan housing is positioned within the standard electrical junction box and at least a portion of the mounting ring is adjacent a flat wall to which the standard electrical junction box is mounted.

16. The LED lighting system of claim **15**, further comprising:
- a plurality of spacing tabs on an inner surface of the sink between the heat sink and the mounting ring; and
- an air intake opening formed between an outer surface of the mounting ring and the inner surface of the heat sink, wherein, responsive to activation of the fan, air flows into the LED light system through the air intake opening, through the two outer openings, through the fan housing aperture, and out the air exhaust openings.

17. The LED lighting system of claim **10**, wherein the lighting system further comprises a semiconductor chip comprising an input coupled to an AC power supply and further comprising a plurality of DC power outputs, wherein the one or more LEDs comprises a plurality of banks of LEDs coupled to the plurality of DC power outputs, and wherein the far is further coupled in parallel with a first of the plurality of banks of LEDs.

18. A method of mounting a light emitting diode (LED) lighting system to a flat surface, comprising:
- inserting a fan housing of the LED lighting system into an electrical junction box adjacent the flat surface, the fan housing comprising an end wall, a dividing wall, an outer opening positioned between the end wall and the dividing wall, and a fan housing aperture within the fan housing with a fan mounted therein; and

coupling a heat sink of the LED lighting system to the electrical junction box, the heat sink being coupled to the fan housing and comprising a platform adjacent the fan housing, a sink wall adjacent the dividing wall, and an air exhaust positioned on a side of the dividing wall opposite the outer opening such that, responsive to activation of the fan, air flows into the housing through outer opening, through the fan housing aperture, and out of the LED lighting system through the air exhaust opening.

19. The method of claim **18**, further comprising coupling a mounting ring to the electrical junction box.

20. The method of claim **19**, wherein coupling the heat sink to the electrical junction box comprises coupling the heat sink to the mounting ring coupled to the electrical junction box.

21. The method of claim **18**, further comprising:

transmitting AC power to a semiconductor chip of the LED lighting system;

transmitting DC power from the semiconductor chip to a first bank of LEDs and not a second bank of LEDs;

transmitting DC power from the semiconductor chip to the second bank of LEDs and not the first bank of LEDs; and

operating the fan at a speed proportional to a brightness of the first and second banks of LEDs.

22. The method of claim **20**, further comprising: operating the fan by transmitting DC power from the semiconductor chip through the first bank of LEDs to the fan.

23. The method of claim **20**, further comprising operating the fan by transmitting DC power from the first bank of LEDs through a filter to the fan.

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